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Bug Bytes 66

To bring their ambitious adaptation of Robert A. Heinlein's classic *Starship Troopers* to the screen, director Paul Verhoeven and producer Jon Davison turned to animation maestro Phil Tippett for swarms of insect warriors, to Sony Pictures Imageworks for epic-scale space battles, and to special effects coordinator John Richardson for on-set pyrotechnics. Others recruited to support the war effort included Amalgamated Dynamics, Industrial Light & Magic, Boss Film Studios, Banned From the Ranch, Compound Eye, Visual Concept Engineering and Kevin Yagher Productions. *Article by Paul M. Sammon.*

Cloning Aliens 98

For *Alien Resurrection*, the latest offering in the *Alien* franchise, Ellen Ripley and the alien fetus within her are brought back from the dead in a film directed by Jean-Pierre Jeunet. Returning as alien purveyors were Tom Woodruff, Jr. and Alec Gillis of Amalgamated Dynamics Incorporated, whose animatronic and suit-based creatures were augmented by digital warriors created by Blue Sky Studios. Overseeing the visual effects—filmed in Los Angeles, but composited by Dubois in Paris—were effects supervisors Pitof and Erik Henry. *Article by Bill Norton.*

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COVER—Futuristic foot soldiers battle alien hordes in *Starship Troopers*.

FLUBBER

PLAYING WITH FLUBBER

ARTICLE BY JODY DUNCAN

The two special effects nominees for the 1961 Academy Awards presentation were *The Guns of Navarone* and *The Absent-Minded Professor*. The former won the statuette, but in the ensuing years, the effects of the latter proved to be the more inspired. Ingenious optical effects, animation, matte paintings and mechanical rigs were all employed to create the story of a professor who invents a flying rubber compound, dubbed ‘Flubber.’ For the Disney remake, *Flubber* — starring Robin Williams and directed by Les Mayfield — the tools may have changed, but an equal measure of ingenuity was in evidence.

Visual effects supervisor Peter Crosman was enlisted to oversee the ambitious effects undertaking, an assignment that would eventually embrace some 550 shots. In fact, the visual effects component of the picture was so large that its second unit was renamed the visual effects unit, which — with Crosman at the helm — worked concurrently with first unit throughout production. The core of the workload lay in the *Flubber* character animation and in scenes featuring the professor’s *Flubber*-powered, flying Thunderbird, and those effects were divided between Disney’s own Dream Quest Images — where about seventy flying car shots were achieved — and Industrial Light & Magic, which computer generated seventy-one performance *Flubber* shots. “There was a natural division in the task at hand,” noted Crosman, “in that the flying car and *Flubber* sequences represented two very different types of effects. So it was easy to divide that work.” To stretch the budget as far as possible, there was a mandate to subdivide shots even further. *Flying Flubber* character animation, for example, which would be subjected to slightly less scrutiny than the performance *Flubber* shots, was farmed out to Hammerhead Productions, Mobility and Computer Cafe — companies that could complete the job more economically than ILM. Similarly, Dream Quest’s vast resources were not a necessity for all of the flying car shots, some of which were composited by Pacific Ocean Post. Ultimately, some three hundred effects shots were divided among more than a dozen other outside vendors.

The movie opens with a scene reminiscent of *Honey, I Shrunk the Kids* or a *Wallace and Gromit* short, as a variety of robots prepare their inventor, Professor Phillip Brainard (Robin Williams), for the start of his day. Handling breakfast preparations is ‘Weber,’ a robot fashioned from pieces of a Weber barbecue. A more sophisticated, basketball-sized flying robot named ‘Weebo,’ who is both the professor’s most impressive invention and his best friend, functions as alarm clock and electronic day-planner.

Remarkably, ninety-five percent of the shots featuring Weebo — a major character in the film —



In Flubber — director Les Mayfield’s remake of the Disney classic The Absent-Minded Professor — Professor Phillip Brainard (Robin Williams) invents an incredibly elastic

were accomplished on the set with a practical robot designed by associate producer Nilo Rodis and built by Gary Platek and his JEX FX crew. “They could have done Weebo entirely through CG,” Platek commented, “but Robin Williams had specifically asked that there be a real robot on the set to interact with. I think he had grown tired of acting with nothing, or acting in front of a bluescreen — as he has in so many of his movies. The story demanded that he have a real relationship with Weebo; so he wanted her to be there on the set with him.”

substance that exhibits a distinct personality and is able to alter shape at will.

In just three months, Platek and crew created two different versions of Weebo, plus a ‘Weebette’ — the daughter of Weebo — for the end of the film. Because the first Weebo had to be delivered quickly, Platek opted to skip the traditional sculpting phase of construction. “We used a CAD system to design it,” said Platek, “then sent that information to a facility that made our molds, which were sent to a vacuform place where all the pieces were made. We then assembled those pieces at our shop.” Mechanical designer Kelly Lepkowsky engineered the all-electronic functions, such as ‘ear flaps’ that could raise and lower, a telescoping eye, the rotation of the main body, raising and lowering bellows and a screen that could flip open and closed. All of the functions were powered through cables that came out the bottom and led to a Kuper motion control system that was connected to a full-size telemetry device, operated by Bryan Dewe. “Any moves on that telemetry device were translated to the Weebo robot. And since it was motion controlled, we could scale up moves. If Weebo was supposed to rotate five times, for example, we could do that with only a quarter-inch move on the telemetry device, as long as the computer had been appropriately programmed.” Other functions, such as ear flaps, were operated by lead puppeteer Robert Cooper on pedal and hand controls, while Platek manned a light-switch box. Weebo’s floating and flying maneuvers through the set were accomplished by placing the robot on a kind of cradle that was attached to a Steadicam rig, operated by Guy Woolley. “Guy was a Steadicam operator, but he really had the sensibilities of a puppeteer. He was very sensitive to the character’s personality and behavior, and he was aware of things like not casting a shadow on her in a shot.”



Most of the Flubber shots requiring character animation were achieved digitally by Industrial Light & Magic. An elaborately choreographed musical number had Flubber subdividing and dancing the mambo.



Production visual effects supervisor Peter Crosman and ILM visual effects co-supervisor Sandra Ford Karpman review storyboards in preparation for shooting plates, needed for the mambo sequence, on an oversize set constructed at ILM.

For each Weebo scene, a clean pass — without Weebo or the other actors — was filmed, allowing for the digital removal of the operator, Steadicam rig, cables and casing on which the robot sat. The digital extractions would be done by a number of companies. “My preference was to work in Cineon,” remarked Crosman, “both because of its file space and the skill of the vendors. So I went to Rainmaker Digital Pictures, a company from Vancouver that was just setting up its L.A. branch. 525 Post Production also did some of that work, as did Pacific Ocean Post.” A second Weebo built by Platek’s crew was configured so that the cables came out the backside, rather than the bottom, allowing the director to frame a small number of shots in such a way as to preclude the need for digital rig removals. Additional nonarticulated Weebos were built by special effects coordinator Stan Parks and his crew, specifically for static Weebo shots, such as those in her dying scene near the end of the movie.



Karpman studies a filmed-out shot.

Weebo’s more sophisticated heir, Weebette, is introduced in the final moments of the film. “Weebette was more high-tech-looking and streamlined,” said Platek, “with a shinier paint job. Weebette was supposed to be Weebo taken to the next stage of development, so it had to look more fully evolved. Mechanically, it was the same as the original Weebo — built through the same computer-aided process — it just had a different look.”

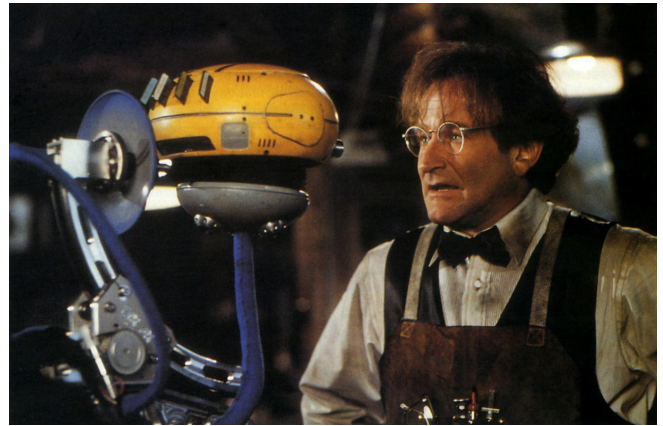
The film’s anthropomorphized title character makes his appearance early on, when the professor’s basement laboratory experiments yield a new energy source — Flubber, an amorphous, bouncing, stretching, translucent, gelatinous, high-energy green blob. Such a magical and dynamic character was best created through digital techniques, a task given to ILM character animation supervisor Tom Bertino and visual effects co-supervisor Sandra Ford Karpman early in the film’s preproduction. “The big difference between this Flubber and the Flubber in *The Absent-Minded Professor*,” observed Bertino, “was that, this time, Flubber was actually a character. He had emotions, a distinct personality, readable thought processes, and he had to interact with the professor.”

The first issue to be resolved was the look of the character, worked out through illustrations by ILM visual effects art director Scott Leberecht, with input from Mayfield and Rodis. “One of the first things I did when I got on the show,” said Leberecht, “was go to the supermarket and buy various types of shampoos and styling gels and gel toothpaste, anything I could find that had a translucent look to it. Then I did a lot of Photoshop work. There were many characteristics that had to be decided upon — Flubber’s translucency, whether or not he’d have bubbles inside of him or sparkles, what color he was going to be, how images would distort behind him, how light would pass through

him, what kind of shadow he would cast, the degree of luminance he would have. Photoshop allowed us to pin down all of those things.”

Once the filmmakers had approved a particular look for the character, Richard Miller in the ILM model shop made a full-size maquette, sculpted in clay then cast in clear resins to which green dye had been added. Gel-like models, rigid and softer, were produced to provide crucial reference on the set and at digital workstations. “We wanted Robin to have something to hold on the set, just to orient himself,” explained Leberecht, “but we also needed something that would show us how light would behave if it were passing through this kind of material. So all of our technical directors had one of these maquettes on their desks. They could hold it up to the light and see exactly what would happen to it under specific conditions.”

A character unlike any the ILM team had ever created, Flubber presented a number of thorny issues, both artistic and technical. “In terms of animation,” recalled Bertino, “the gauntlet was really thrown down with this show. ‘You call yourselves character animators? Here’s the ultimate challenge. Make us believe in and care about this blob with no head.’ It didn’t have eyebrows we could raise, or any other facial characteristics to create expression; so we had to go back to silent movie techniques, expressing emotion purely through body English. Flubber had to demonstrate fear, joy, doubt, confusion, anger, pride, strength, all through his body. Fortunately, we had a team of crack animators who really knew their craft. Animators wanted to come onto this project, because it was the kind of playful, purely visual storytelling that we don’t ordinarily get a chance to do.”



Robin Williams interacts with Weebo, a flying robot invented by his character. Most of the shots featuring Weebo were achieved on set with a practical robot mounted on a variety of rigs that were either framed out or digitally removed.

The biggest technical challenge was the fact that Flubber took on numerous shapes throughout the narrative. “Flubber was constantly changing form,” Bertino commented. “Some of those forms were humanoid, and some were bloblike, and some were in-between. It had a certain form when it got scared or startled; it had forms it took on when it was bouncing; it had a specific form when it was just sitting in the professor’s hand. The important thing, from our standpoint, was that Flubber could shape-shift at any time, and that those shifts in form were internally driven by the character.”

Early on, Bertino and Karpman recognized that the typical modeling and animation techniques ILM had used for projects such as *Jurassic Park* and *The Lost World* would not be effective in creating Flubber. “Ordinarily,” Karpman commented, “we model things in CG that have a specific form and shape and weight. Even a CG dinosaur model is fixed and controlled — that dinosaur has four legs, and it always has four legs, all the way through the movie. But Flubber was constantly changing forms, going from a blob of jello in one shot to an almost human-looking character in another. So when we were figuring out how to do this, Tom and I realized that traditional CG models and animation techniques were not going to work for this show. There was no way to do Flubber with ILM’s usual method of building patch-based models. It would have had to be a tremendously high-

resolution model to enable it to have an arm come out suddenly, for example, and then disappear again. In a sense, it would have required building one model that could transform into a hundred different models. That wasn't feasible with patches."

The solution to the problem was Metaclay, a blobbies tool in the Softimage animation package. Rather than defining model surfaces with patches, Metaclay forms spheres that, in close proximity, combine to form a shape. "These Metaclay spheres behave something like mercury would in a gravity-free environment," Karpman explained. "You can have a basic shape, but you can also make something protrude out of it. Because of that characteristic, Metaclay is a very quick modeling tool."

"Working with Metaclay was similar to doing traditional hand-drawn animation," Tom Bertino elaborated. "In traditional animation, you have to recreate your character over and over again as you animate it. With Metaclay, we had to continually recreate the shape of Flubber as it moved through its transitions. It was like molding, with clay, a new shape for each key frame, rather than just taking an existing model and moving it from place to place. It called for many more aesthetic decisions and interactions than does normal CG animation work because we had to remodel it from frame to frame and from shot to shot."

Both its speed and its blobbie qualities made Metaclay the ideal modeling tool for Flubber, but there was one major drawback: since Metaclay was not designed for the purposes of animation, the tool did not accommodate the creation of motion blur. "With a patch-based model," said Karpman, "you have a clear start and stop point in any movement of the model. You can animate an arm to make a big sweeping move, and the tip of the finger is always at the tip of the finger. So there's a definite arc of movement that can be tracked and measured to create motion blur. But Metaclay recreates the model's surface for every frame. Frame one is one shape, frame two is another, and frame three is yet another — and there's no set point for all three. So figuring out how to create motion blur was a major issue." Ultimately, the motion blur problem was solved with the application of software, written by John Schlag and incorporated into ILM's proprietary lighting tool, Ishade.

ILM's character-animated Flubber appears in several key scenes: the 'birth of Flubber' sequence in the professor's basement; a scene in which the professor tries to convince his fiancée, Sara (Marcia Gay Harden), of his discovery's remarkable capabilities; an exuberant mambo dance number featuring multiple Flubbers; a battle sequence between the professor and the thieves who have stolen



Weebo creator Gary Platek, of JEX FX, examines the inner workings of the robot, which was powered through cables connected to a telemetry-driven motion control system.

Flubber; and a final scene in which Flubber — in the flying T-bird with the professor and Sara — plants a kiss on an airplane, to the astonishment of a little boy looking out.

The most challenging of the sequences was the dance, which comprised twenty-two of ILM's shots and ran more than two minutes in length. As conceived and executed, the sequence was a tour de force of character animation. "Flubber really stands alone in this sequence," remarked Bertino. "He subdivides, creating his own dance partners. He forms the shapes of musical instruments. He takes on human characteristics, like arms and legs. The intent was to reveal how Flubber has matured as a character, a chance to show him feeling his oats and testing his limitations." With only a vague directive in the script to 'insert dance number here,' the ILM digital team was given the rare opportunity to actually invent the sequence, rather than just deliver already conceived effects shots. "We pretty much created the sequence, with the director's input, of course. That was a wonderful experience for us."

Backed by Latin-style music written by Danny Elfman, the mambo sequence was storyboarded by Bertino and Scott Leberecht, who referenced dance numbers in old Busby Berkeley movies from the forties and fifties. "Those old films gave us inspiration," said Leberecht. "We also started thinking of all the different kinds of gags that could happen in the middle of that dance routine."

Leberecht's mambo storyboards were translated into animatics to guide both the on-set plate shoot and the subsequent Flubber animation. Those animatics reflected a very fluid style of camera movement. "I knew the animation would be beautifully choreographed by Tom," remarked Karpman, "and I wanted the camera work to complement that with graceful moves and tilts. I wanted the camera to be just as choreographed as the dance number was going to be." To ensure appropriate camera work on this and other CG Flubber sequences, Bertino and Karpman were on set for the filming of live-action plates. To accommodate Robin Williams, who lives in the San Francisco area, the shoot was conducted primarily at an abandoned military base on Treasure Island. Throughout the live-action shoot, the supervisors relied on the skill and cooperation of director of photography Dean Cundey, who had worked with ILM on effects films such as *Jurassic Park* and thus understood CG's special requirements. "At the start of the shoot, I took a jar of Dippity-Do and I shined a flashlight on the front of it for Dean. I said, 'Okay, this is what Flubber looks like frontlit.' Then I shined the light behind the gel and pointed out what a big difference backlighting made. It looked much more beautiful and interesting backlit; and Dean was very cooperative in giving us as much backlighting on the set as possible."

Williams, too, was a veteran of effects films such as *Hook* and *Jumanji*, and easily adapted to the task of acting against an invisible co-star. "At first, Robin had the tendency to hold Flubber in his hand as if he was the size of a golf ball," said Karpman, "when, in reality, Flubber was the size of a grapefruit. Prior to a take, I'd go in and adjust Robin's hand. I only had to do that a couple of times, though; and from then on, he always held his hand correctly. His background as a mime was very helpful in his ability to physically interact with this invisible character."

Bertino and Karpman also appreciated Williams' remarkable improvisational skills, which resulted in an unusually spontaneous on-set atmosphere. "It was a great experience to watch a scene develop organically on the set," said Bertino, "rather than have it entirely preplanned. But it did add a level of difficulty to our job. Since no two takes were alike, we never knew until we got our cut

sequences what version of the scene we'd be matching our Flubber animation to. We had to have a separate group of measurements and camera setup data for each version — then we'd pick one, depending on what take ended up in the final cut."

The flubber-powered flight of the professor's 1963 Thunderbird convertible required several different setups to create images of the car floating among clouds, spinning, turning and banking. For most shots of Williams in the flying car, Stan Parks and special effects supervisor Dan Sudick mounted the full-size T-bird to a McFadden motion base, in front of a 120-foot-wide bluescreen. The hydraulic base allowed the T-bird — with the actor inside — to tilt up to sixty degrees and, from its center position twelve feet in the air, raise and lower a total of seven feet. For in-camera shots, meant to look as if the car were floating on a layer of clouds, Dean Cundey had the full-size T-bird mounted onto flotation devices in a tank filled with giant cutout clouds and a layer of CO2 gas.

Supervisor Douglas Hans Smith, who oversaw all of Dream Quest's work on the sequence, was on set throughout the shoot. Two motion control systems, one for the motion base car and one for the motion control camera and crane, ensured that programmed moves could be repeated for a matte pass against black, if too much blue spill appeared on the shiny car. "The matte issues could have been disastrous," Smith asserted. "In fact, we'd taken the full-size Corvette from Con Air that we had at Dream Quest and shot it rotating in front of a bluescreen — and half the car disappeared. That gave us an idea of what could happen with the T-bird. So we came up with the idea of filling in blue spill areas with a CG car, in some cases. Shooting a matte pass of the full-size car against black was just another way of ensuring that we could resolve those issues." At one point, the camera was programmed to travel, at great speed, forty feet towards the motion platform, as the car swung toward the advancing camera. "In the interest of speed, some of the moves were being done without careful previewing. In this case, the program sent the car crashing right into the camera. I was yelling: 'Stop! Stop!' There was this horrible crunching sound. It broke the matte box off the Panaflex camera, and it dented the car a bit — but it could have been much worse."



Scenes of Professor Brainard's Flubber-powered flying Thunderbird were achieved by Dream Quest Images, utilizing both full-size and miniature cars and backgrounds.

Shots in the flying T-bird sequence that could not be accomplished with the full-size rig were relegated to the Dream Quest model shop crew, which — under lead modelmaker Curt Engelmann — built a fifth-scale T-bird. The 42-inch replica was small enough to mount onto a standard motion control rig, yet just large enough to allow for appropriate detailing. "The model crew sculpted the whole fifth-scale body," recalled Smith, "and then they pulled molds from that and built the car out of resins and other materials. For reference, we brought in a real 1963 T-bird."

Positioned on Dream Quest's boom arm stage, the T-bird model was shot against greenscreen. On the opposite end of that stage was a fiberfill cloud setup, filmed separately and composited with imagery from both the full-scale and model car shoots. Because of the volume of footage required, Smith had toyed with the idea of creating the clouds digitally. "I'd worked with fiber clouds before,"

Smith stated, “and making them look real is a huge hassle. But digital technology right now is such that it would have been difficult to generate that much material in a timely fashion. The fiber clouds gave us something tangible immediately.” Sixteen different fiber cloud shapes were mounted on C-stands and poles, their positions on stage reconfigured for each shot. The clouds were photographed motion control, with frontlight-backlight techniques providing the necessary mattes.

To make the fiberfill cloud material as realistic as possible, the shots were tweaked digitally. “We broke them up,” Smith noted, “judiciously adding CG layers, with motion, in front of certain areas. Allen Battino, Dream Quest’s art director, went in on some shots and added a 2-D painting that could be tracked to the clouds to break up their edges. Those kinds of digital enhancements made these fiberfill clouds very successful.”

In the first flying scene, the professor makes his way to Sara’s house, the lights of her neighborhood twinkling below. A real neighborhood in San Jose was filmed to provide some of the background plates; for others, the Dream Quest model shop, under the guidance of Jim McGeachy, constructed a sixteenth-scale neighborhood miniature, based on measurements gathered on location by Ramon Juncal. The model measured fifty feet square and included thirty to forty individual houses and some two hundred trees, all handmade from organic materials. Detailing included street signs and lights, fencing, piles of firewood, picnic tables, basketball hoops, hopscotch drawings on sidewalks, cars in driveways, and backlit interiors made up from stills. Houses and trees were arranged shot to shot, as needed, and filmed motion control, with the camera hanging from a gantry rig to capture an aerial point of view of the flying T-bird.

The background skyline of the neighborhood was provided by painted cycloramas, filmed separately. The painted skylines — one twelve-by-twelve feet, the other eight-by-fifteen — were designed to show the point of view from the ground level and the sky above, respectively. “We wanted the freedom to do moves on the model,” said Smith, “and then duplicate those moves on the cys. An interesting question is why we didn’t do digital matte paintings for the backgrounds — and that’s the type of question that presents itself with every show. What do you do digitally and what do you do with a model? One major factor is the comfort level of the people involved. Another is whether all of the tools are in place at a particular facility to commit to a specific technology. In this instance, I felt that I’d get faster feedback if I did it with painted cys. Since there were scheduling issues involving other in-house productions, the digital work wasn’t going to start concurrently with the model shoot. With the cys, I had all of my pieces fairly quickly.”



Marcia Gay Harden and Robin Williams perform in the full-size T-bird, which is mounted on a hydraulic motion base in front of a bluescreen.

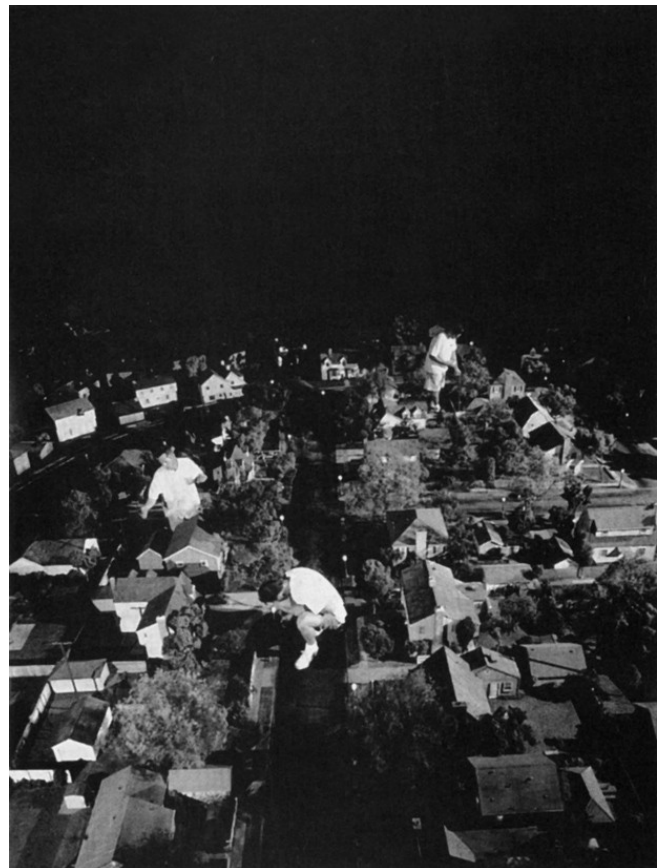
Smith had opted to produce many of the shots on Dream Quest’s slate through miniatures; but the facility’s CG team became heavily involved in the show during the postproduction phase, creating a digital Weebo for shots that could not be achieved with the live-action robotic puppet — shots such as Weebo flying up to the roof of a house, or fighting with the movie’s villains.

Reference footage for the CG Weebo shots had been obtained on the set by walking a cutout 'Weebo on a stick' through its intended moves. Armed with that reference material, the Dream Quest digital team — headed by CG supervisor Darin Hollings — created a digital model of the robot. "It was a fairly easy thing to model," commented Hollings, "since it was so geometrical. We just sat the real one on a desk and measured it and took photos of it to match, and then hand-built it. It was really the perfect kind of object to do in CG, because all of its motions are rotational and mechanical." Animation of the robot was handled in Alias, with a system of sliders that enabled animators to easily articulate movements such as Weebo's ear flaps raising and lowering. "We had a lead TD go in and write all the mathematical equations to make the sliders work; then we handed those out to everyone. But even though the modeling was straightforward, we still had to match the character and personality of Gary Platek's Weebo. The production had watched hundreds of takes of that Weebo, and they had very specific ideas on how she should look and act."

A digital T-bird was also built, initially intended only to fill in the blue spill areas of the full-size car that had been shot on the motion base. "The idea was to create a CG replica of the car," said Hollings, "and track it in, just kissing in those areas where it was needed. Viewpoint DataLabs sent a team of people out to the set to collect the data. They took tape and made a grid out of the whole car, then hit each vertice on that tape grid with a digitizing arm. We got this wire-frame car back from them, which was beautiful and matched exactly." The final rendering of the car was handled at Dream Quest, where Studio Paint was used to apply appropriate textures. The team also used shaders it had already developed for the CG Corvette in Con Air to create rubber textures for the tires, as well as textures for the car taillights and headlights.

Once the CG T-bird was available, Doug Smith found applications for it that went beyond just using it to fill in areas of the full-size car. "As often happens during production, the number of car shots increased, and stage time was limited," Hollings commented, "so Doug came to me and asked if we could use the CG car for some of the shots, and I said, 'Absolutely.' We put a little CG Robin Williams in the car, as well, made from a cyberscan we had of someone, which was tweaked to make it look a bit more like Robin Williams. But it was a pretty rough likeness; so with the CG car stuff we could not get too close to the driver. As a result, we mostly did the faraway stuff, where you couldn't see Robin Williams clearly. We simply motion-path-animated the car into the scenes and key-framed it. It was pretty basic."

Reflections on the model or full-size car were added by moving the imagery through a virtual environment. "We set up what could be described as a digital tunnel with painted clouds on it," said



Hollings. “As we moved the car through that tunnel, the clouds reflected on the car and the windshield.

~~From-Quadrant models photographed animation controls for the flying sequence.~~

In one shot, we needed the reflections of the neighborhood as the car is traveling through, so we took the miniature neighborhood background, flopped it, and ran that by the car.”

Reflection elements were supplied to digital compositing supervisor Mario Pabon and his crew. The most harrowing of their composites was the spinning car, which had to be tracked to a bluescreen element of Robin Williams in a rotating driver’s seat rig, without benefit of tracking targets. “That particular shot,” noted Crosman, “had been cut from the budgeted flying sequence; but at the insistence of Les Mayfield, it was filmed anyway — just in case we could get it in the show. Unfortunately, there was no time to properly prepare the staging for effects work in post.”

“It was a real challenge,” Pabon affirmed. “The footage of Robin spinning in the car seat — filmed so that his clothes and his hair would really appear to be upside down — needed to be tracked in order to extract the motion and match it to the separate footage of the car, which was shot locked off. In addition to the rotational movement, Robin’s body shifted as he spun around, which made the tracking process even harder. On some rotations, his hair hung down beyond the edge of the bluescreen, so there was a lot of complex roto work, too.”

To find the center of Williams’ rotation, without benefit of guides, Pabon looked for points that were parallel to each other and to the actor, and that had sufficient contrast to make them visible at all times. “It was very difficult,” remarked Pabon. “Shadows would cover the area and we would lose track; so we’d have to go back and find another area. It was a matter of deciding, somewhat arbitrarily, to make particular points on him the tracking points — like buttons on his coat, or something like that. Once we had all the tracking data, we had to determine that it was precise, so that when we composited in the car, it would spin at the exact same rate Robin Williams was spinning in this rig. To determine that, we took the data and inverted it — where there were positive numbers, we put in negative ones, and vice versa. We completely inverted the tracking curve and applied it to the spinning image of the actor; and by doing that, we got an image of him that was not spinning. If our tracking was wrong, we would see some movement in that image; if it was right, the image would be perfectly still. We didn’t get it right the first time, of course; we had to keep adjusting and rechecking.”

Fortunately, the labor-intensive, painstaking work involved in the spinning car composite was the exception rather than the rule. Most of the effects work for Flubber, in fact, was characterized by a sense of unbridled creativity and fun. “What I enjoyed about the show was that the humor and the gags were the main thing,” noted Scott Leberecht. “We weren’t constantly struggling to make Flubber look like something from nature — which is what we are so often faced with. Once we got the technology down, it was a creative process entirely. Flubber allowed us to play.”

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MOUSE HUNT OF MICE AND MEN

ARTICLE BY ESTELLE SHAY

The inimitable W.C. Fields once cautioned fellow thespians never to share the limelight with children or animals. Surely he would have recoiled in horror at Hollywood's current penchant — given the opportunity and the technology — for upstaging its actors with everything from reconstructed dinosaurs to talking pigs. Case in point is *Mouse Hunt*, a Christmas offering from DreamWorks SKG, the fledgling studio forged by Steven Spielberg, Jeffrey Katzenberg and David Geffen. With first-time feature film director Gore Verbinski at the helm. *Mouse Hunt* takes the concept of performing critters to new heights, introducing as the comedic heart of the story none other than a tiny field mouse.

In the screenplay by Adam Rifkin, squabbling brothers Ernie (Nathan Lane) and Lars Smuntz (Lee Evans) are brought together by the death of their father, Rudolph, who bequeaths to them jointly the family business — an antiquated string factory — and an equally dilapidated, seemingly worthless old house. When misfortunes in their lives subsequently force both brothers to take refuge in the house, they stumble upon blueprints that authenticate it as a long-lost Charles Lyle LaRue original — a rare architectural treasure worth millions. Determined to reap the full measure of their inheritance, the brothers set about cleaning up and renovating the mansion in preparation for the auction block, only to discover that it's longtime tenant — an uncannily resourceful and tenacious mouse — has no intention of vacating the premises.

Essentially 'Home Alone with a rodent,' the *Mouse Hunt* script was a grab bag of Laurel-and-Hardy-style gags, piling one calamity after another on the hapless Smuntzes in the course of their increasingly obsessive attempts to exterminate the pesky creature. Although the filmmakers knew they could rely on the expert comedic talents of Lane and Evans, the driving force for much of the comedy would nevertheless rest on the tiny shoulders of the mouse, whose antics provide a convincing foil for the brothers' shenanigans. "The mouse in this film is not supposed to be a personality, like Babe or *Casper*," stated visual effects supervisor Charles Gibson. "It never talks or makes faces or mugs or anything like that. A lot of the humor comes from the fact that it's supposed to be an ordinary mouse who just happens to do some amazing things. If you stop to think about any of it, you realize how preposterous its behavior is, but it seems logical in the context of the film."

In order to bring the minuscule character to big-screen life, veteran animal trainer Boone Narr, owner of Boone's Animals for Hollywood, spent six months training a cadre of mice to perform many of the complicated stunts and tricks called for in the script. It was obvious from the start, however, that some form of effects-driven surrogate mouse would also be required — particularly for scenes in which the rodent was required to behave in distinctly human-like ways. To provide the necessary backup, Verbinski and producer Bruce Cohen called upon two Oscar-winning companies, Stan Winston Studio and Rhythm & Hues. Having just completed work on *The Lost World*, the Winston organization would trade



In the Gore Verbinski comedy. *Mouse Hunt*, two brothers attempting to renovate an old mansion they have inherited are bedeviled by a resident mouse. Although

large-scale robotics for the micro world of mouse animatronics, while Rhythm & Hues, best known for imbuing farm animals with the power of speech in

trained mice were employed extensively during filming, visual effects were also essential.

Babe, would direct its digital prowess toward the creation of a computer generated double. Besides supervising 150 shots, Rhythm & Hues company co-founder Charlie Gibson — assisted by visual effects producer Jenny Fulle — also oversaw the digital contributions of a host of outside vendors, among them Animal Logic, Blue Sky/VIFX, 525 Post Production, Rainmaker Digital Pictures, Image G and Pacific Title Digital. Additional visual effects were provided by Robert and Dennis Skotak of 4-Ward Productions, while *Mouse Hunt*'s ambitious slate of on-set gags was directed by special effects coordinator Michael Lantieri.



Rhythm & Hues computer generated a mouse for scenes requiring complex actions that real mice could not be trained to do.

As early as June 1996, a full nine months before filming was slated to begin, Verbinski gathered his effects teams together for a strategy session. “It was important to understand what the real mouse was capable of doing, and what kinds of shots would require an effects solution,” said Gibson.

“Interestingly, we discovered that the opposite of what one might expect, in terms of real mouse behavior, was true. We thought, ‘A real mouse is never going to be able to walk all the way across a table full of pots and pans, stop at a certain point, then go through a cup handle — that’s way too complicated.’ But it turned out you could train a mouse to do that. What it couldn’t do well was just sit still and look into the camera.” Out of the planning sessions grew a strategy for the division of shots and methodologies, broken down for each storyboarded sequence.

Closeups of the mouse involving human-like expressiveness and gestures would be the domain of Stan Winston Studio. Fresh from building T-rexes and raptors, the Winston team began work on an animatronic mouse — a seemingly simple task that quickly proved otherwise. “Nothing went quite as expected,” Winston related. “When we were doing dinosaurs, we had a fair amount of artistic license because no one has ever actually seen a dinosaur. But in this case, everyone knows what a mouse looks like, so we found ourselves dealing with a far more exacting standard of realism.”

Besides holding up to close scrutiny, the fake mouse also had to intercut seamlessly with shots of the real mice. “Getting the lighting and depth of field, the width of the whiskers and the subtleties of the hair on our puppet to work at a magnified level that precisely matched the real animals was no simple matter,” stated effects supervisor Shane Mahan. “The production was using maybe sixty different trained mice, each with slight variations in color. We had to come to a common ground for our animatronic, and determine what differences we could get away with. As it was, we ended up going back to the drawing board a couple of times on the skin and hair to get the fur density and color just right. After that, we depended on cinematography and lighting to help make it all work.”

To accommodate an array of intricate internal mechanisms, the puppet was built oversized — four-and-a-half times larger than life. But even scaled up, the challenges were considerable. Having analyzed mountains of reference material, the Winston team elected to use soft foam in constructing the mouse body. “A mouse is a very squishy little animal,” said Mahan. “It’s always kind of compressing or inflating. It can go under little cracks in doors because it’s so flexible. So we thought rather than have too many hard skeletal structures inside, we’d make him light and floppy-looking. That way we could flatten him down or puff him up.”



Animatronic mice for on-set use were created by Stan Winston Studio.

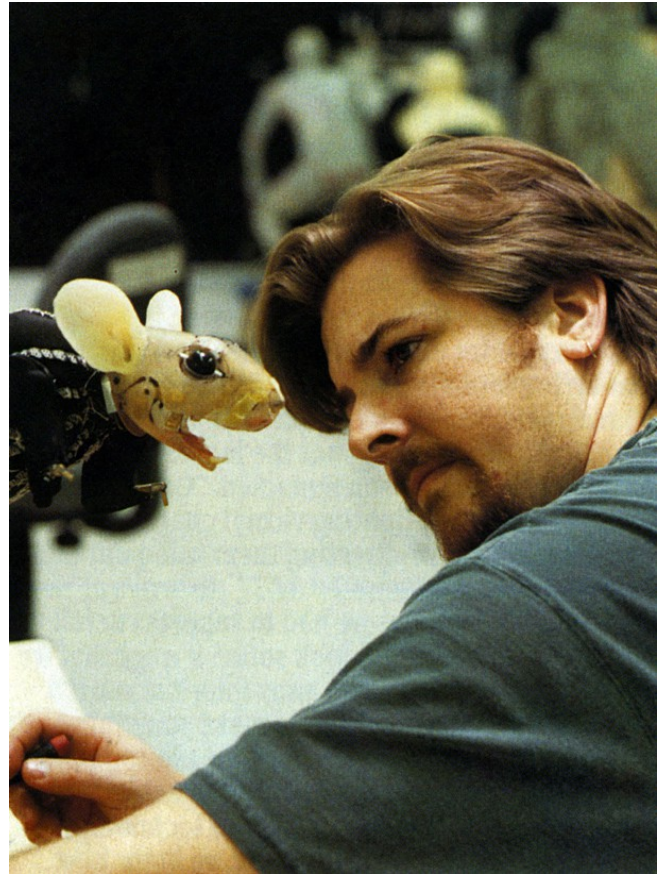
From a sculpture by Paul Mejias, the body was fabricated by Lynette Eklund out of hot-melt material, with small metal legs attached and covered in silicone skin. Mechanics, designed and built by Christian Colquhoun and Al Sousa, included those required for remote-controlled facial articulation, cable controlled head and neck movement and telemetry-controlled mechanical arms. Internal bladders simulated breathing movement, and an opening in the soft body enabled puppeteers to reach a hand inside and create torso movements. Hair for the animal's dense pelt was hand-tied by Stuart Artingstall, Ursula Ward and Eklund.

Six members of the Winston crew puppeteered the animatronic mouse on special scaled-up sets erected by the production at Raleigh Studios. "We had to create a believable performance that conveyed recognizable human emotions," commented Winston, "which is hard to do because a mouse's anatomy is so different from ours. And since mice are not normally very animated creatures, we had to find ways to make it so." Prior to filming, puppeteers rehearsed extensively on a stage set up at the Winston studio. "We wanted to make sure that each puppeteer could work off of the rhythm of the next person, and be able to do specific moves or just ad lib if necessary," explained Mahan. "Our team got quite proficient at keeping the performance alive and interactive." The puppet could accommodate a range of expressions, both subtle and not-so-subtle, although Verbinski frequently opted for the subtler approach as shooting progressed. "It was kind of a joke. We would say: 'Okay, that was the Jim Carrey version. Now let's do the Marlon Brando version. We'd do a lot of funny, cute pauses, punctuated by reactions from the mouse. But then Gore would say: 'Let's not go so human. Let's pull it back a bit, make it more mouselike.' He didn't want the character to be completely cartoony. He wanted to keep it right on the cusp — it was funnier that way."

Also built by the Winston team was a mechanical cat for a dozen or so stationary full-body shots and closeups of a feisty feline named Catzilla, recruited by the brothers to solve their vermin problem. Opting for a distinctly cartoonish approach, modelmakers worked from approved concept art by Mark 'Crash' McCreery. Unlike the mouse scenes, they were not hampered by the need to precisely match a live animal counterpart. "The only time a real cat was substituted was in instances where it's running across the floor," said mechanical designer Richard Landon, "and those were either long shots or filmed over the shoulder." With license to play up the comic aspects of the character, modelmakers spared no pains. "Originally we were going for an escaped-lab-experiment look, but we ended up toning that down because it looked too sorrowful and pathetic. Instead, we went for the ultimate monster alley cat — basically just a real bruiser."

Built at 150 percent scale from sculptures by Paul Mejias and Scott Stoddard, the mechanical cat had interchangeable heads — including one with a neutral expression and another that was angry and open-mouthed. Mechanisms built by Landon, Matt Heimlich and Chris Colquhoun included posable front and rear limbs and fully articulated face, head, neck, shoulders and body. "A lot of the mechanical design was based on the work we'd developed for *Lost World*," stated Landon. "We had a brand-new control system for the radio controlled functions. It was puppeteered just like we did the dinosaurs, with a telemetry controller that matched all the internal construction inside the puppet externally. Puppeteers moved the external device, and the computer and radio controls would translate that signal to our animatronic."

While animatronics represented an essential ingredient in the mix of *Mouse Hunt*'s visual effects, no less important was the use of computer animation to create key performance moments in which the film's title character is seen acting in ways well outside the bounds of ordinary mouse behavior. Early on, digital artists at Rhythm & Hues, led by Gibson and animation supervisor Sylvia Wong, had begun gearing up for the assignment. An oversized maquette, provided by the Winston crew, served as a rough basis for the creation of a digital mouse, modeled by Nancy Klimley using custom software. Photographs of the real mice featured in the film provided added reference, with modelers mixing and matching the best mouse features in order to come up with an ideal representation.



Mechanical designer Jon Dawe puts an unfinished mouse puppet through its paces.

A key consideration in the creation of the CG character was that it not only be realistic-looking, but animatable as well. “That’s not as simple as it might seem,” Gibson noted. “From a setup standpoint, this was absolutely the most sophisticated CG creature we’ve ever done. We could take all the statistics — like range of motion and caliper measurements — off a real mouse and reproduce them precisely. But our mouse also had to be able to do all this stuff that a real mouse could never do — like turning its head back and looking over its shoulder, or sliding down a banister on its back. It needed to look good and have structural integrity in these extreme poses, or the audience would see through the trick. To do that, we had to respect the anatomy and physicality of a mouse while finding ways to violate them in a realistic manner. That’s something we learned to do on *Babe*, where we started with accurate models of the dogs’ mouths — properly placed jawbone controls and all that — but ended up putting in a lot of controls that dogs don’t have. It was always done in the context of a real dog’s anatomy, however, so it didn’t seem wrong.”

Custom software, designed as an open-ended architecture, made it possible for Sylvia Wong and animator Chris Perry to develop a strong, physically based model. “Rather than relying on standard animation software to bend the creature’s arms and legs and body, kind of like *Gumby*,” stated Gibson, “Sylvia and Chris developed a system for defining volumetric structures for bone and muscle so that we could get sophisticated skin and fur movement on the surface of our mouse. They also adapted our software to incorporate as much automatic, reactive behavior as possible, so that the animation team could just concentrate on performance. For instance, mice have a way of compressing themselves into a little ball. But when they stretch out, their spines, which are hinged at the back of the neck and on top, enable them to really flatten into low, sleek creatures — almost like little surfboards with legs. That behavior was set up in the model so that it would happen automatically when our animators put the mouse into certain poses.”



Lynne Watson applies hair to one of the oversize creations.

Animators also experimented with variable walk cycles. “At one point, we decided we needed another speed for the mouse’s movement,” Gibson said. “We had walking and running, but for dramatic purposes we needed a galloping-for-dear-life mode. So we completely fabricated a move that a real mouse could never do. It was similar to the motion of a large cat running, but in the context of the scene it seems natural. One thing we found out is that a mouse moves so quickly, you can’t express the complexity of its actions in a single frame of film at 24 frames per second. We had to animate our CG mouse like it was in slow motion, then speed everything up in our renderer.”



Hair department chief Stuart Artingstall and effects supervisor Shane Mahan add finishing touches to the animatronic mouse.

Special software, written by Harold Zatz, added realistic, organic-looking fur to the final renders. “We wanted fur that was art-directable,” explained Gibson, “that we could ruffle or slick down to match the live-action mice. It also had to be really three-dimensional. Harold and Chris Perry ended up creating geometric fur whose properties were controlled through texture mapping and painting, illuminated by a shader that we could put into our renderer to simulate very fine detail. That gave us the best of both worlds — we could control the length, density and color, and we could use the shader to add all the minute detail that you really need to show fine hair on the big screen. As an added benefit, we were able to integrate the fur with our animation setup so that it appears to react to movement and lighting. When the mouse bends its head, the fur develops little kinks and ripples.”

Matching the digital mouse to stage lighting was a key factor in integrating the character with live-action footage of its real-life or animatronic counterpart. “Computer graphics is pretty terrible at reproducing anything but the most simplistic of lighting effects,” Gibson remarked. “Consequently, a lot of the work in lighting virtual characters and objects involves art-directing them using our more crude tool set and some 2-D tricks to arrive at the right look. Sometimes we had to suppress detail in our mouse to make him look softer. It’s not that we were cheating or throwing away information; it’s just that ultimately we have to make something that’s consistent with the rest of the photography in the film. There’s a solid foundation behind everything that we do. We know what our technology does, we know what reality is, and we know how to bridge the two.”

Shots relegated to the CG mouse ranged from subtle reactions — deadpan looks and expressions — to highly physical, action-oriented behaviors, such as rolling a wheel of Gouda cheese, sliding down a banister, swinging from a light bulb chain or clutching the exhaust pipe of a moving car. “The exhaust pipe scene — we called it our ‘Cape Fear’ shot — was the very first one delivered,” recalled Gibson, “and it was an interesting place to start. The mouse has just survived an explosion, and, unbeknownst to the brothers, hitches a ride under their car. Not only did we have to soot him up and make him look ragged and dirty, we also had to make his fur blow in the wind and track him onto the exhaust pipe of a real moving car in the live-action plate.”

Animators trod a delicate line in their efforts to instill personality and character in the computer generated mouse. “Sometimes, if it involved a really short cut, we could get away with a broad, exaggerated performance,” observed Gibson. “Other times, when the mouse was really large in frame and the animation had to hold up to much closer scrutiny, we needed to be really clever about the way we integrated human performance characteristics.” At the film’s conclusion, a twenty-five-second shot — featuring the digital mouse, perched on Ernie’s shoulder, taking bits of food from his hand — combined broad performance strokes with more recognizable mouse behaviors. “That was one of our most difficult shots, because our character is on screen so long. We took several of our favorite behavioral bits and used those as inspiration for the base level performance. Then we added the real performance beats where the mouse actually interacts with Nathan Lane.”

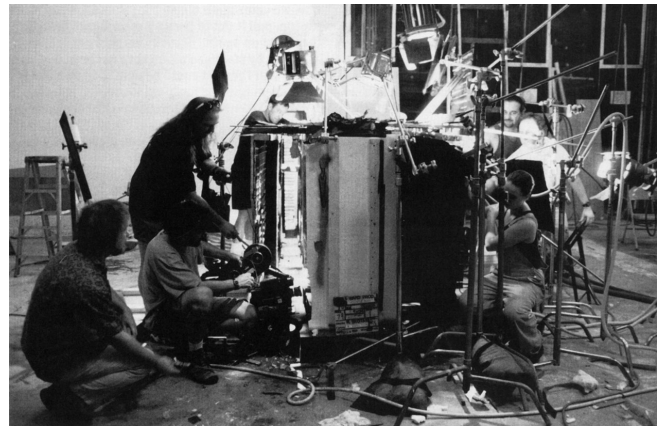
Not all of the digital mouse effects involved a 3-D clone. In some cases, artists merely enhanced footage of the real mouse — a technique perfected by the Rhythm & Hues team during *Babe*. “Rather than substituting the entire live-action mouse with its CG counterpart,” stated Gibson, “we would just add a subtle head twitch or eye movement through computer enhancement. By digitally manipulating the real mouse’s face a bit, or adding an artificial performance beat such as a pause and an eye blink, we could make it look as if he was thinking or reacting or getting an idea.” Not only the mouse was subject to such digital tweaking. For a shot in which the rodent slides down a banister right under Ernie’s nose, digital artists altered Nathan Lane’s eyeline to more precisely follow the action of the CG character. “It was a simple thing, but it made the scene a lot funnier.”

Months before the start of filming, Verbinski, Gibson, Narr and director of photography Phedon Papamichael had spent time exploring photographic and lighting issues for all of the mouse scenes. “We went through a very important phase where we started photographing the real mice,” said Gibson. “We looked at those shots, projected together with the animatronic and the CG versions, and tried to figure out how best to shoot them. We discovered that it was actually quite difficult to make real mice appealing on screen. There were definite unflattering angles that made them look ratlike. Through testing, we learned that using the right lenses and finding the right angles and lighting conditions could make the character much more attractive. We also learned that a lot of in-camera tricks could be used to give the mouse personality and a sense of intent. Mice are hyperactive little creatures that twitch a lot and move really fast — they’re actually hard to watch for any length of time. But we found that by playing with frame rates, and through a combination of photographic tricks and staging, we could make a mouse look like it was walking purposefully or even reacting thoughtfully.”

With much riding on the effects photography, a special mouse photography unit was established, headed by Mark Vargo, who also directed some of the film’s second unit work. Vargo, in collaboration with Gibson, would be responsible for capturing much of the CG mouse effects plate photography and intricate mouse point-of-view shots. “One of the things that was really interesting about this film was the juxtaposition of the miniature world of the mouse and the regular-size world of Ernie and Lars,” Gibson observed. “Mark did a beautiful job lighting the micro-world shots. Even though he was working in such tiny scale, those shots never felt compromised or any less rich or complex than the live-action photography.”

Continuing with testing that had begun during preproduction, Gibson and Vargo experimented at length with a variety of nontraditional camera techniques and special lens systems in preparation for the shoot. “The whole special photography issue turned out to be laborious,” observed Gibson. “The mouse is a character as important as any other in the film, and finding a way to express that photographically was crucial. When you see a mouse in real life, you’re usually looking down at it and seeing just the top of its body. But if our audiences were always viewing it from that perspective, they couldn’t get to know the character. At the same time, we were trying to remain consistent with the look and feel of the first unit stuff, so our mouse photography wouldn’t look like we were cutting to some National Geographic documentary in the middle of the show.”

To help audiences bond with the character, views of the mouse frequently included eye-level and point of view shots filmed from mouse perspective. Shooting at mouse scale, however, was no simple undertaking. “Depth of field was a critical issue,” said Vargo, “to the point where sometimes we couldn’t even hold the entire mouse in focus. Rather than overlighting just the mouse scenes — which would have taken them out of context from the rest of the film — we decided to bite the bullet and stick with the existing look. Also, we found that at mouse scale, every crumb on the ground becomes set dressing, and has to be art-directed. At times, we were literally putting grains of dirt and dust down like they were set pieces.”



Scenes inside a flooded wall were achieved by Robert Skotak and 4-Ward Productions using a live mouse and sophisticated digital compositing.

Two elaborate sequences depicting the mouse moving within the walls of the house required complex motion control setups. The first — a twenty-second segment, shot entirely as a mouse POV — occurs as the brothers, snacking on olives in their kitchen late at night, discuss plans to sell the mansion and make their fortune. Beginning with a view of them through a chink in the attic floor, the subjective camera traces the mouse’s movement as it races under attic floorboards, down a pipe from the roof and along a zig-zagging track in the wall. “We shot the attic floor with the chink in it and bluescreen behind the hole,” stated Gibson, “comping that to get the initial framing so you see the brothers through the hole. Then we matched the tilt-up on the live-action with our motion control camera and started the journey from beneath the attic floorboards down through the interior walls of the house.” Completed in just five days, the mouse’s journey through the house was filmed on a series of four low-tech sets representing the interior wall environment. Using a Bulldog motion control rig — provided by Image G and operated by Adrian Hurley — Vargo and Gibson shot the sequence with the aid of a snorkel lens system equipped with a pitching mirror that could be rotated to make it look as if the camera were tilting as it negotiated the sets. “We’d rough in the motion control program, then go in and literally choreograph our way through — a mere fraction of an inch off the floor. Because we were not shooting in real time, and didn’t have to worry about banging into anything, we could get really precise — just barely off the ground. We could even hop over little pebbles, if needed. It created a great mouse perspective for the sequence.”



Key fabricator Lynette Eklund assembles a killer feline engaged by the brothers — another Winston creation.

More than forty passes were needed to complete the complicated passage through the sets. “We had to shoot multiple passes on each set,” said Vargo, “because we were negotiating the camera under a series of wooden floor joists — which the mouse has ostensibly gnawed through — and around various other obstacles that appear along the route. Every time we came upon one of the joists, we would have to stop, pull it out of the way, reconfigure the set, then start up again.” Transitions between sets were achieved by placing a bluescreen at the end of one set, so that the next could be matted in to make the move seem like one long, uninterrupted passage.

“We did some wacky things to try to keep the POV interesting on every leg of the journey,” noted Gibson. “At one point, the mouse appears to pass through the spinning blades of a fan — which was put under motion control as well, so we could precisely program the phase of the fan to work in sync with the camera. At another point, where the mouse runs down a wire, we did slow-motion pixelation animation on the wire to make it look as if it were vibrating from the weight of his footsteps.”

In the kitchen, the wily rodent emerges from his hole to purloin an olive that Ernie has dropped, rolling it into the hole. The scene combined a CG olive, courtesy of Animal Logic, with a real mouse. In a subsequent shot, a real mouse’s face was digitally altered by Rhythm & Hues to add expression. Compositing of the entire sequence was accomplished by Pacific Title Digital.

Motion control, coupled with a seamless blend of modalities and scale, also figured into a later sequence which sets the stage for the man-versus-mouse conflict. The scene opens with the mouse crawling through the walls of the house to get to his lair, where he crawls into his comfy sardine-can bed. Drifting off to sleep, he is jolted awake when Lars begins repairing a strip of loose molding with a nail gun. Intercut in the sequence were shots of the real mouse and footage of the Winston animatronic in a scaled-up set. As the nails come crashing through, the mouse runs a gauntlet of the spikes, barely escaping impalement.

To make it look as if the nails punching through the wall were barely missing the terrified creature, the subsequent action was filmed in two passes. “One was a motion control camera move on a real mouse running,” Vargo explained, “and the second was of the nails piercing the wall. Besides using the motion control rig to run camera and focus, we used it to time the firing of the nails — which were on pneumatic air rams — through the wall. By figuring out exactly when they needed to fire in order to occupy nearly the same space as the mouse in each frame, we could make it look like the mouse was just an eighth of an inch ahead of the nails as they came through the wall.” For a scene



Mechanical designer Richard Landon prepares to install a dilating eye mechanism.

of the mouse screeching to a stop a fraction of an inch from one of the protruding nails, the real mouse and nail were replaced with computer generated substitutes, devised by Rhythm & Hues. Elements were later composited by Alex Frisch at 525 Post.

While the visual effects team wrestled with mouse issues, special effects supervisor Michael Lantieri faced an entirely different sort of challenge as main unit shooting for *Mouse Hunt* commenced in March 1997 on location at the Bonnie B Ranch in North Fork, California. There, construction crews under the direction of production designer Linda DeScenna had erected a full-size set to represent the exterior of the LaRue mansion. Lantieri's first assignment was to transform the twenty-two acre landscape into a wintry wonderland.

An Academy Award winner for his work on *Jurassic Park*, Lantieri had just completed its sequel, *The Lost World*, prior to joining production a mere eight weeks before the start of principal photography. "In *The Lost World*, we were moving great big heavy things around as though they were nothing," Lantieri commented, "so I thought it would be fun to follow that with a film in which we were dealing with things that had to be nudged and moved very delicately by a mouse. Of course, I also thought it would be this little vacation movie, but it didn't turn out that way at all."

Having underestimated the scope of the *Mouse Hunt* assignment, and with barely enough time to ramp up to speed, Lantieri and his crew of ten-headed by special effects foreman Don Elliott and rigging effects foreman Tom Pahk — launched into what conceivably qualified as the biggest snow job in Hollywood history. "In addition to rolling out snow blankets and gypsum to cover all twenty-two acres," Lantieri recalled, "we also had to make a 105,000-square-foot lake on the property appear frozen. We tried every possible combination of materials for the frozen lake effect, with little success. Finally, Tom happened upon bluish-white polyethylene beads — a raw material used in industry for extrusion — that floated half underwater, half above, and took on the consistency and color of ice just perfectly. They formed a skin effect that you could look at from three feet away, and you'd think it was ice. But it took forty tons of the stuff to do the job; and when we were done filming, it all had to be cleaned up."

Mouse Hunt opens with the funeral of Rudolph Smuntz, father of Ernie and Lars. Unlikely as it may seem that Rudolph's dying wish for his two sons to run the family string factory will be respected, misfortune quickly forces the brothers together. For Ernie, the bad luck comes in the form of a culinary disaster at his posh restaurant involving the local mayor and a cockroach that makes an untimely appearance in a serving of lobster loaf. Australian effects house Animal Logic, under executive producer Chris Godfrey and animation director Lynne Cartwright, was enlisted to create a computer generated roach for a scene in which the insect crawls out of a cigar box that Ernie has retrieved from his father's effects, and a subsequent scene in which the horrified mayor spits out the roach's head — as its headless body wanders off the plate.

Closed down by the health department, Ernie takes refuge with Lars in the ramshackle mansion bequeathed to them. Investigating a noise in the attic, they discover an old box labeled mothballs and open it, releasing a cloud of vibrantly colored digital moths that encircle them before exiting through a hole in the roof. *Blue Sky/VIFX* — under producer Josh Jaggars and digital effects supervisor Derek Spears — created 150 CG moths for the scene, matching real moth reference photography provided by the production. "It was all done in Houdini," stated Spears. "We looked at

doing the moths as a flocking instinct, but ultimately chose a particle system approach because Gore wanted the behavior of the moths to appear very random and individual. We tracked the scene in 2-D, and developed a particle system that allowed us to fly the moths around the room in a chaotic fashion. It turned out to be more difficult than expected because we were walking a fine line between random behavior and needing to follow very scripted paths in which the moths had to fill the space a certain way, interact with the characters and objects in the room and exit by a certain frame.”

Having stumbled across old blueprints for the house, the brothers soon discover the mansion’s true worth and begin sprucing it up for the auction block. In the first of many mouse-induced mishaps, Ernie spies the mouse’s distorted reflection in a glass jar as he and Lars attempt to haul an antique bathtub up the stairs to a second floor bathroom. Startled, he loses his grip on the tub, which bumps back down the stairs, flipping the brothers inside. Smashing through the front door, the runaway fixture picks up speed while negotiating a snowy hill, finally coming to rest on the nearby frozen lake — where it promptly drops through the thin ice.

While indoor portions of the stunt were filmed on a set at Raleigh Studios, subsequent shots of the tub bursting out the front door and onto the lake were captured on location. To carry the tub out to the middle of the ostensibly frozen expanse, the physical effects crew — working underwater in the real lake — constructed an eight-foot-wide, ninety-foot-long pier and painted it to blend into the icy-looking surface. With the aid of a stunt crew led by stunt coordinator James Arnett, they used a cable hooked to a ratchet-and-winch system to tow the tub at high speed onto the pier and out to the middle of the lake. The actual breakthrough was staged separately. “Once again, we had to work off the bottom of the real lake,” remarked Lantieri. “We built a weak-knee system out of steel rigging, with the tub sitting on top so that we could sink it. Then we melted paraffin wax, cut it into chunks and sprayed it over the top of the water to give the appearance of thickness to the ice as it broke.”

Their renovation plans disrupted by the mouse, the brothers’ simple methods of rodent eradication — totally ineffective — give way to grander and more bizarre schemes. For a sequence in which Ernie and Lars cover the kitchen floor with wall-to-wall mousetraps, Lantieri and his crew designed and built 1500 custom mousetraps, installing them on the stage set at Raleigh. “Each trap had a wire on it,” said Lantieri, “that was hooked, through holes drilled in the floor of the stage, to a release system installed below ground. It looked like fifty strung pianos under there, with all the wires run through, like a routing system, to the same place.” The ruse backfires as the wary mouse — computer animated by Rhythm & Hues — drops a cherry onto a spoon, which sets off the traps, launching them in waves at the brothers. “We had three people under the floor using a knife cutting system to cut the wires and spring each trap in order, from one to 1500. We had rigged the traps with high spring tension, so they were flying eighteen inches into the air, snapping everywhere and hitting each other. The faster we pulled, the faster they would go.” To enlarge on the effect, 525 Post composited in several dozen additional mousetraps, shot against bluescreen, flying even higher in the air.

One of the more dangerous stunts staged by the physical effects crew was for a scene in which Caesar (Christopher Walken), an overzealous exterminator hired by the brothers, feeds a miniature camera through a mouse hole in an effort to pinpoint the creature’s location. Inside the wall, the

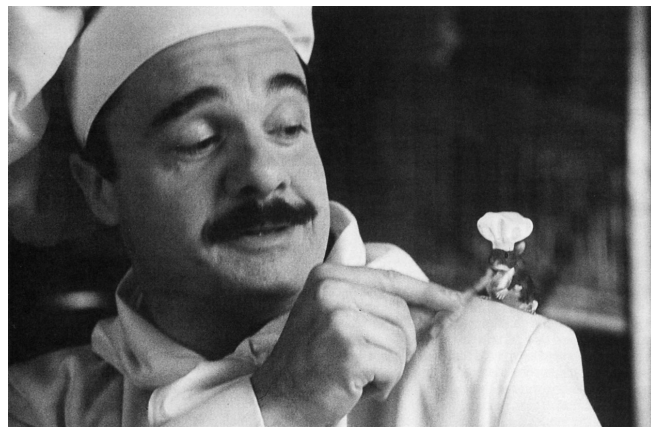
mouse grabs hold of the camera probe — which is attached to Caesar’s belt — and runs it through the house and outside, where he attaches it to a winch on the extermination truck. Before Caesar can react, the mouse jumps on the winch lever, activating it and causing Caesar to be yanked off his feet and dragged beneath the floorboards of the house. To accomplish the sequence, stuntman Seth Arnett — doubling for Walken — was outfitted with a custom backpack that acted as a slide and attached to a track, allowing Lantieri and crew to yank the stuntman along on a cable through specially rigged sets. At one point, Caesar is dragged down a sixty-foot curved staircase. “We used custom stairs made out of very thin balsawood,” said Lantieri, “and pulled him along so that he just split the stairs right down the middle. For some shots we put Chris Walken face down, with the camera underneath the floor, so you could actually see his face as he broke through the wood.”

As the brothers’ obsession with the mouse escalates, Lantieri found himself engineering increasingly complex gags. In one episode, Ernie becomes stuck up the chimney as he struggles to catch the wily rodent. Unaware that the mouse has turned on the gas in the fireplace, Lars lights a match, blowing Ernie out the chimney and onto the lake where he lands in the now-submerged tub. “We did an on-set explosion on a chimney set piece for the first part of that sequence,” noted Lantieri. “But the landing was staged on the backlot at Universal, where we hung a stuntman, lit him on fire and dropped him through a fake ice lake, filming with the camera underwater.”

For wide shots of Ernie flying through the air as he exits the chimney, artists at Rhythm & Hues created a computer animated double and tracked him into the plate photography.

In a later episode, Ernie grabs a shotgun and fires at the mouse inside the kitchen floorboards, piercing, instead, a powerful bug bomb left behind by Caesar. The device explodes, vaporizing the floor and plummeting Ernie and Lars into the basement below. “We took about a twenty-by-twenty-foot area of the kitchen floor set out,” Lantieri related, “and replaced it with tempered glass held up from underneath by lumber laced with primacord. The tempered glass was painted black and covered with silkscreen material to look like the hardwood floor. Then we sprinkled black powder in between the silkscreen material and the glass, so that it would burn the top really quickly with our stunt people still standing there. As the floor burned, we blew the lumber and shattered the glass, dropping our stunt doubles — who wore fire protection gear and were suspended from wires — down into a hole.”

When the long-awaited auction is finally conducted at the mansion, more mouse-induced mayhem awaits the distinguished attendees. Water pumping into a mouse hole from a hose, inadvertently left on during an earlier attempt to flush the rodent out of his lair, floods the house, rupturing a wall behind the auctioneer and unleashing a tidal wave of water. The flood was staged by Lantieri in a tank at Universal Studios. “We put up three walls, and behind one of them rigged 45,000 gallons of



Rhythm & Hues animated a CG mouse to interact with actor Nathan Lane during a closing scene, after the brothers and the mouse have reconciled.

water,” Lantieri elaborated. “Then we put our stunt people in there and basically just dumped the water through a breakaway wall, washing them right out of their seats.”

For a sequence of shots inside the walls of the house, forecasting the tidal wave of destruction, Jenny Fulle turned to Robert Skotak of 4-Ward Productions. “There were about eighteen or twenty shots,” said Skotak, “that fell into an odd category involving live-action footage of real mice, but with an effects component requiring very specific art direction.” The segment begins with several establishing shots of the mouse navigating passageways inside the walls, while water is seen building up behind a dammed-up space. As the water pressure reaches critical mass — squirting out from a single board held in place by one rusty nail — the camera pans around and tilts to reveal the mouse off in the distance. Subsequent shots reveal the mouse running toward camera just ahead of the rushing water and later bobbing on its surface in a Dixie cup boat.

Given just four weeks to produce the segment, Skotak and brother Dennis — who shared camera duty with project producer Mark Shelton — rented a nearby stage. Gathering together an effects team, they erected custom micro sets dressed with various mouse artifacts gathered by Fiasel Karim, who co-art-directed with Jim Towler. Watertight dikes and dams were built to contain the sets so that they could be flooded repeatedly. “A lot of my job was heavy-duty art direction for the lighting and set dressing,” Bob Skotak elaborated. “Gore was great at conveying his artistic vision. He is heavily influenced by Eastern European puppet films and the stop-motion work of the Brothers Quay — which is very bleak and Kafkaesque. I’ve done a lot of research in that area; so as soon as I talked to him and saw some of the footage that had been shot, I knew exactly what he wanted.”

Working with low-profile cameras, tiny sets and fifteen trained mice made for a difficult shoot. Scenes of the mouse running toward camera just ahead of the rushing water required two passes — one for the mouse and another for the water. “Everything had to be locked down — all the little boxes and spools of thread and dolls and figurines — or you’d see a jump in the objects between the dry and wet passes.”

To obtain tight-focus closeups of the mouse, it was generally necessary to coax the tiny creature to within an inch of the camera lens — which was problematic. “Whenever the mouse saw its reflection in the lens,” stated Skotak, “it would become fascinated and forget to act. We ended up doing 137 takes to get one good one.” To film the mouse bobbing along in its makeshift boat, both rodent and cup were installed on a mover hidden underwater. “If the mouse got just one drop of water on its face, it would stop acting and start wiping its face — which was completely unacceptable. So here we were, in a space about eight or nine inches wide, with pipes and set detail in the foreground, and our camera dolly and crew crammed in there. There were hoses and pumps to make the water look like it was surging, and water spraying all around this little mouse — and we’re trying to keep its face dry. It called for a whole level of micromanagement.”

Mouse Hunt concludes with one of the film’s most elaborate and visually stunning gags — the collapse of the three-story LaRue mansion. The collapse occurs just as Ernie, desperate to put a positive spin on the disastrous events of the evening, declares to his now waterlogged guests that the flood is proof positive a LaRue home is built to last. No sooner are the words spoken than the house — eroded by water damage — implodes behind him in a pile of rubble.

Lantieri carefully planned the implosion with an eye toward precision timing — essential for the humor of the gag — and safety, since Nathan Lane would be standing with his back to the event, a mere forty or so feet away. Working early on with construction coordinator Bruce Gfeller, Lantieri had provided specifications for building the 56-foot-tall facade that would enable him to collapse it once shooting was completed. “We came up with a plan that involved attaching the entire facade structure to a system of fifteen telephone poles located on the inside, so you could not see them. We weren’t sure how, but we figured if we could just get the telephone poles to fall, they would take the house down with them.”

Later, Lantieri and Tom Pahk would devise the means for pulling down the poles to create the implosion. “We rented some concrete freeway barriers and hung one off each of the telephone poles, tying them to the walls of the house. Then we rigged explosives to sequentially cut the cables that were holding the weight of the barriers, so that as they fell they would pull the walls in with them.” Another problem that had to be addressed was the issue of the fifteen telephone poles that would be left in the shot. Hoping to avoid a digital fix, Lantieri drilled holes at strategic points in each pole and loaded them with primacord to disintegrate two feet out of the middle so that they would fall in as the house collapsed and look like part of the debris.

With only one chance to get it right, Lantieri carefully mapped the placement of each explosive for brother Louie Lantieri, who loaded and wired the set. Filming of the implosion went off without a hitch. “With something like that you need to be really careful because of all the explosions going off sequentially. If the first two explosions cut the rest of the wires — you’re in trouble. It’s like a big chess game.” Out of fifty-six tons of glass, wood and cement falling, only one pole was left standing that had to be painted out of the shot.

Having bungled their chances for wealth, Ernie and Lars ultimately reconcile with each other — and with their nemesis when the mouse helps them to transform the near-bankrupt string factory into a string cheese factory. Lantieri and his crew, who had earlier outfitted an old brewery in downtown Los Angeles with antiquated, but working mechanisms for winding, weaving and threading string, faced one final hurdle. “We had to take all of those machines and motors and spools that we had concocted and set up with string, and turn the string to string cheese — all 50,000 feet of it!”

With its offbeat, edgy humor and wholesome good fun, *Mouse Hunt*, which opened on Christmas Day, proved a popular holiday treat for moviegoers. In addition to the spectacular pratfalls of Lane and Evans, what made the film unique was the performance of their tiny costar. “It was like dancing on the edge between reality and fantasy,” remarked Charlie Gibson, of the process involved in bringing the lovable rodent to the big screen. “After a while, we began to discern that edge between ‘it’s a real mouse’ and it’s an unreal mouse.’ But the goal was always to have Boone Narr come off as the world’s greatest mouse trainer. If everyone thought that, our job would have been done really well.”

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AN AMERICAN WEREWOLF IN PARIS WEREWOLF WIZARDRY

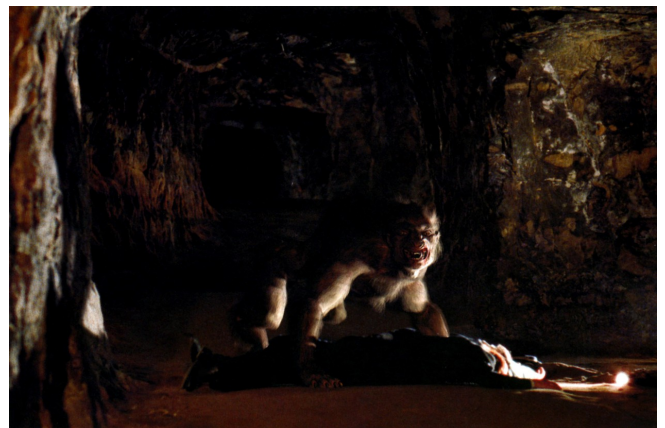
ARTICLE BY MARK COTTA VAZ

In the pantheon of Hollywood motion picture icons, some of our most memorable characters have also been the most horrific — Lon Chaney’s contorted Hunchback of Notre Dame, Bela Lugosi’s dark and menacing Count *Dracula*, Boris Karloff’s hulking *Frankenstein* monster. Up there with the best of them is Lon Chaney Jr.’s Wolf Man, whose tortured descent from human into hairy beast would spawn a succession of werewolf mythology films leading right up to the present day. Until recently, however, efforts to create a true lycanthrope for the cinema — traditionally accomplished with physical effects, optical dissolves and cutaways — have produced a creature more akin to man than wolf, no matter how sophisticated the makeup or how loping the gait.

Modern advances in makeup prosthetics and animatronics have resulted in some breakthroughs, one of the more noteworthy efforts being the in-camera transformations of John Landis’ 1981 cult classic *An American Werewolf in London*. Now, with the release of its followup, *An American Werewolf in Paris*, digital technology has finally freed the werewolf from the constraints of the physical world and the actor’s human form. “The effects star in that first film was Rick Baker and his prosthetics work,” said John Grower, founder of Santa Barbara Studios, the company tagged by director Anthony Waller to oversee visual effects for the sequel. “But you never saw a full-blown werewolf running and jumping. The challenge that Anthony brought to us was to create a creature without resorting to a guy in a rubber suit.”

Co-written by Waller, who, with producing partner Richard Claus, had purchased the sequel rights for their independent production company Cometstone Pictures, *An American Werewolf in Paris* follows the same premise as its predecessor. A young American traveling across Europe with his friends is bitten by a werewolf and falls prey to the age-old curse. In this case, the American — Andy (Tom Everett Scott) — becomes obsessed with a beautiful, but mysterious Parisian girl, Serafine (Julie Delpy), whose life he saves when she attempts a suicide leap off the Eiffel Tower. Andy is quickly drawn into the intrigue surrounding Serafine — a lycanthrope under the thumb of a gang of werewolf skinheads led by her ex-boyfriend, Claude (Pierre Cosso). Andy and Serafine join forces, eventually confronting the rogue werewolves and foiling their plans to purge Paris of its human population.

For the new film, Waller envisioned a werewolf that went way beyond the pale of past incarnations — a beast seven feet tall and weighing 700 pounds, able to stand on two legs or ambulate on all fours. In addition, the werewolves inhabiting *American Werewolf in Paris* would be seen in every conceivable scenario — haunting ruined churches and dark catacombs, stalking victims in the bright lights of a Paris Metro subway car, leaping from the stagnant water of an old fountain, even engaging in combat with each other. Not only was it necessary for Santa Barbara Studios to create a digital model that could perform the fantastic actions as scripted, its artists would also have to contend with that longstanding bugaboo of computer generated imagery — hair.



To convey a sense of human-animal duality impossible to achieve fully with actors playing the roles, werewolves in the Anthony Waller film, *An American Werewolf in Paris*, were computer animated by Santa Barbara Studios.

For SBS, the undertaking was particularly ambitious, representing as it did the company's first outing as primary visual effects contractor on a feature film — albeit a low-budget, independent one — and its first foray into feature-film-quality character animation. “We’ve been known for delivering work on time and on budget, and for being innovative,” said Grower. “So even though we’d never done a big character animation job, much less one with fully articulated, hairy werewolves, Richard Claus trusted that we’d figure it out.” Claus had originally met Grower on *500 Nations*, a CBS documentary on native Americans for which SBS had contributed digital imagery that ran the gamut from Aztec temples to aerial views of Mayan cities. Favorably impressed with the company, the producer expressed interest in working with them at a future date. “He said: ‘We’re going to be doing some feature films — independents, smaller budgets. Would you guys be interested in working with us?’ And, of course, we said, ‘Sure!’”

The visual effects demands of *American Werewolf* — encompassing some 175 shots, fifty of them involving a digital werewolf — would, however, belie the film’s small, independent status. “We had a high degree of confidence that we could pull it off,” said Grower, “but there were a couple of big unknowns. The biggest was the hair technology, which really didn’t exist in off-the-shelf software. Industrial Light & Magic had developed hair for *Jumanji*, and Digital Domain had created a different kind of hair technology for *Island of Dr. Moreau*. But we had heard that one was computationally expensive; and the other, we felt, wasn’t quite right for a werewolf. So we figured on having to come up with our own.”



A major challenge for the digital effects team was the creation of computer generated hair for the hirsute lycanthropes.

Another big unknown, at the beginning, was the number and complexity of shots that would be required. “There was a gentlemen’s agreement between Richard, Anthony and SBS,” stated Grower, “that we would back into the budget, and just make sure we delivered the best quality possible for the amount of money available.” To that end, Waller and the SBS team began a close collaboration during the four to five months of preproduction, story-boarding each sequence and designing shots that could conceivably be done within the allotted budget “Our workload actually increased during that time. Not in terms of the number of shots, but in level of difficulty. We were getting some very positive results from our discussions and development, and realized we could do more than we had originally thought.”

Anticipating the challenges that lay ahead, SBS expanded its personnel fourfold. Even so, the staff still only numbered about forty — a crew size comparable to that of a single department in a major effects house. Lean but mean, the company recruited such talent as animation director James Satoru Straus, who would fill the position vacated early in preproduction by Eric Guaglione. Formerly of Industrial Light & Magic, Straus had supervised the groundbreaking computer animation on *Dragonheart*, earning an Academy Award nomination. Bruce Walters, another ILM alumnus and owner of XO Digital Arts, was recruited on a subcontract basis to supervise the European plate shoot and digital matte painting work.

In addition to ramping up all aspects of its operations — including character animation, compositing and editorial — SBS also had to deal with the logistics of a production in which principal photography and background plate work were slated to proceed in Paris and Luxembourg, with Waller and his editorial departments likewise based in Europe. Central to SBS's success would be its incorporation of a high-tech system that allowed the staff to communicate with the production's various far-flung entities. "By the last third of the project," recalled Grower, "we'd brought on-line a job tracking system that enabled us to keep tabs on where everything was in the pipeline. We probably couldn't have done it without that, since there was such a huge amount of data. Tied into the whole system was an e-mail function within a protected website that allowed the director, no matter where in the world he was, to download data instantly. Prior to that, we were sending video tests by Federal Express, which had a two-day turnaround."

As principal photography got underway, Walters flew to Luxembourg to oversee the all-important plate shoot — an exercise in seat-of-the-pants filmmaking. "The conditions there were very difficult," stated Grower. "There was no real sound stage to speak of, and many of the sets were built with very little money. We had to just make do with what we had." Unable to locate a theodolite — a surveying instrument often used to obtain accurate measurements necessary for the integration of computer generated effects — the plate crew gathered data the old-fashioned way, using protractors and tape measures. "Because we had limited resources and equipment," stated Walters, "we had to be clever and resort to primitive techniques, like videotaping plates and putting animation cels over them. We'd ship them to Santa Barbara so that SBS could see what we had in mind for shot composition and camera lineup." SBS animators would later utilize the data to replicate backgrounds and camera moves in the computer.

To capture suitable live-action backgrounds for subsequent insertion of the CG werewolves, Walters and his crew carefully planned out each shot on set. First, the scene was blocked with a performer doing the werewolf actions. Lighting reference data was obtained by filming a large white ball attached to a stick and moved through the set along the exact trajectory of the werewolf. Finally, a detailed hairy mockup of a werewolf torso was mounted on a pole and run through the scene to provide animators with live-action data pertaining to the play of light on the fur, the density and position of shadows, and other on-set dynamics.

Also used on location was an animatronic werewolf suit — created by Magicon & Crawley Creatures, which contributed an array of prosthetic makeup effects for the film. The animatronic approach was a hedge in the event that SBS could not produce a CG werewolf convincing enough for closeups. Ultimately, the practical werewolf would be used only sparingly. "I was worried, at first, about pulling off the hair," admitted Grower. "But our computer generated werewolves did look good in closeup; and as we refined our work and the animation crew got better and better at it, we ended up using CG for many of those shots."

While first unit and plate photography crews labored in Europe, artists at Santa Barbara Studios set out to justify Claus' faith in their abilities. Beginning with Waller's notion of a 700-pound creature, SBS art director Peter Lloyd developed the werewolf design through a series of drawings and miniature clay figures. "The biggest challenge," Lloyd stated, "was conceiving something that could walk on two legs and run on all fours. We designed the werewolf legs with some canine

characteristics, but built up with muscle mass. The werewolf also had a rounded, human-shaped head, which gave it a distinctly intelligent look — canny, and at the same time, powerful and magnificent.”

From his initial rough sketches and sculptures, Lloyd took the design work into the digital realm, developing the particulars in both 2-D and 3-D imagery. “I scanned photos of a fourteen-inch-tall clay werewolf I had made,” Lloyd explained, “and worked out the hair design, skin texture and other issues in Photoshop.” Lloyd’s drawings were also the basis for a four-foot model, sculpted by Leo Rijn. A mold from that sculpture was then sent to Viewpoint for digitizing. “I took that 3-D model and worked out the same issues of hair and skin texture that I had been addressing in the Photoshop 2-D image; only now I could rotate the werewolf and work on it in the 3-D Alias paint program.”

The digitized sculpture also served as the basis for the animation models, fashioned in wire-frame and equipped with hundreds of built-in controls. “We built four different levels of complexity into the models,” commented James Straus. “The first was a render model, which had everything in it — controls on top of controls dictating how the skin moved with the body, how the spine twisted and bent, how the muscles jiggled — all these parameters involving structures that could either be animated or were automatic. While the heavy, complex model could do everything, it was not something you could animate easily. So we made three versions that were strictly animation oriented. One was a full-control model, stripped down to just the animation controls — but even that wasn’t fast enough for some of our needs. So we had a second model that was a lot faster and a lot more interactive, with just the important controls on it. We could get very nice performances out of it, and reserve the heavy animation model for fine tuning. Then, because we had some scenes that were so complex we needed real-time interaction, we made a fourth version — a real-time, super-fast model, that was a whole different breed. Built with simplicity and speed in mind, it was so small that we could animate in real time, even with shading on. We could see where the arms and feet were going and do complex choreography very quickly. We could work out acting issues, show them to the director, make changes immediately, then show him a new take several hours later — it was that fast.”

A small, but determined, animation team, lead by Straus and comprised of just one half-time and two full-time animators, began the difficult task of creating believable werewolf performances. Using Softimage as their principal character animation tool, the animators relied on ingenuity to rev up the software. “One of the exciting things about new versions of Softimage,” noted Straus, “is that you can write expressions inside the interface to make the computer model do things. I built sensors into the model — really just objects attached to strategic points on the body that served no purpose except to know where they were in space — and wrote expressions that, at every frame of animation, could look at those sensors and determine the werewolf’s body orientation. The CG model could then take that information and mathematically adjust itself in important ways. For example, if it detected that the werewolf’s body was horizontal to the ground, it would make the shoulders behave much the way a lion walks, with the shoulder blades working in a reverse rotation. But if the creature were starting to go upright, like a human, then the sensors would detect that, and the shoulders would automatically react by fully conforming into a new mode, where they behaved more like a human shoulder. It was sort of a primitive form of artificial intelligence.”

Other tools Straus and his team built into Softimage included a means of controlling the curl of the lupine lips and additional facial expressions. “We developed specialized tools to adjust how the envelope operated on the skin, how the skin would deform when the bones underneath moved around. For our first blocking, we would use the really fast, interactive model to get all the artistry in the performance into the animation. Then I could worry about the nitty-gritty of how the toes spread when they compressed on the ground or where the eyeline was at any given moment — those things I could do on the more complex models once I got the bigger, more important issues out of the way.”

Going into the production, the SBS team had determined that there was already film precedent for realistic-looking computer generated hair, which offered some hope that an even more organic look was at the brink of a breakthrough. “The lion that ILM did for *Jumanji* was pretty believable, so we felt that what we wanted was doable,” recalled Phil Brock, director of research and development who — with computer graphics supervisor Scott Gordon, lead technical director Pete Travers and software engineer Matt Rhodes — would tackle the werewolf fur problem. “Since we had not done hair before, much less a big character animation show, we took a two-pronged approach. I started writing the hair renderer while James Straus and Scott Gordon began exploring all the character animation software. The hair was particularly complex because not only is hair hard to do in CG, but these werewolves were not like teddy bears, with generalized fur. Our werewolf had different kinds of hair. It had a long mane, but it also had short curly hair in other places. The hair color varied, too — about seventy percent of it was brownish black, with the rest silver, brown and reddish.”

The team’s plan was to design the fur along NURB — for non-uniform rational beta — lines, a mathematical representation of surfaces that works at a much higher level of detail than regular polygons. Since the werewolves would be seen at various distances, from far range to terrifying closeups, it was vital that the 3-D hair be realistic and detailed enough to hold up to close scrutiny. “The hair had tremendous amounts of sub-pixel detail,” Gordon said. “There were hundreds of hairs in a single dot of information.” Of two basic rendering approaches, a volumetric strategy had been dismissed because it did not allow for the hairs to be distinguished individually — a must, given that the production had figured on werewolf closeups. Instead, the artists opted to create geometry for every single hair.

“Each werewolf model had over 360,000 hairs,” Brock estimated. “The renderer would create a hair image for a certain frame, with the hair composited on top of the skin, which was rendered in Mental Ray. When we rendered the skin, we also had to know where the hair was casting shadows, because the skin, in addition to containing patches of thick hair, also had areas of less hair where it could actually be lit. The renderer had to take all those shadows and environmental issues into consideration. Another issue was that our images couldn’t take forever to render — the times had to be reasonable. To render



Among the most difficult effects scenes was one in which a werewolf leaps out of a fountain — rigged on set with

360,000 hairs at twenty to forty minutes per frame at video resolution was fine; but it couldn't take four hours, because when we went to film we'd be looking at more than ten hours per frame, which was way too slow. So both speed and image quality were of highest priority. We created some unique algorithms that allowed us to keep our render times efficient, finally achieving one to three hours per frame, with full motion blur within the renderer."

Among the most difficult effects scenes was one in which a werewolf leaps out of a fountain — rigged on set with air cannons to produce the splash — and shakes CG water from its CG fur.

Numerous practical effects and digital tricks were employed to help integrate the werewolf animation with background plates. "We shot a lot of live elements for breath and blood using things like dry ice, syrup and milk," Gordon related. "We had scenes, for example, in which the CG werewolves would be in a cold crypt at night. To suggest icy breath we composited in dry ice, shot with a video camera. It was easier to come up with a practical effect — something we could shoot in an afternoon — than it was to create a program to simulate icy breath. But we used CG tricks, too, to make it look like our werewolves were interacting with their environment. For example, in a scene in a moving subway car, where a werewolf grabs onto a bar, we did a digital replacement of the bar and bent it so that it looked like it was flexing under his weight."

An *American Werewolf in Paris* opens with Andy, intent on impressing his daredevil friends, preparing to bungee jump off the Eiffel Tower. Preempted by Serafine's suicide leap, Andy — still attached to his bungee — follows her over the railing in a bold attempt to catch the woman and save her. Clasp ing Serafine's hand just seconds before she strikes the ground, he drops her gently, then rebounds to the top of the tower. The ten-shot sequence, a series of fast cuts, tricky perspectives and complex camera angles, was overseen by CG supervisor Mark Wendell. Early on, Wendell had generated animatics for the sequence from storyboards by Phill Norwood. "Production used the animatics in a kind of video overlay to plan out greenscreen shots of the actors on wires," said Wendell, "with the camera pulling back to make it look as if they were falling." Initial down-angles of the two actors plummeting toward the ground required digital manipulation in order to create realistic falling dynamics. "In four or five seconds, physics dictated that they would fall maybe 200 feet. But production didn't have that much length of set and track for the camera to move on when they shot the actors. So I generated templates in 3-D — using rough shapes to represent the actors — indicating how fast and how far they needed to fall, and where they would be in the shot. Then we matched the live element of the actors to those templates, scaling them in 2-D."

Lateral views and up-angles utilized a CG sky background, with the camera tracking its subjects as they fell. "Because the director wanted a kind of hand-held, shaky look to those shots — as if somebody in a building a few hundred meters away was trying to track them with a long lens — we did a lot of post 2-D cropping and panning to get that kind of natural feel." Views of the Eiffel Tower sweeping by in all of the shots featured a huge digital model — loaned to SBS by Media Lab — that required more than a month of heavy massaging before it could be rendered and painted.

Andy and his friends trail Serafine to her home, where her terrible secret is revealed during a full-moon transformation, one of several on-screen werewolf transformations that occur throughout the film. The sequence — a combination of CGI and prosthetic effects — was designed to look like one long, uninterrupted shot. "We definitely didn't want it to be like a typical morph," stated Straus. "Also Anthony didn't want the changes happening all over at once. He wanted them to develop in certain places, then travel along her body as the camera followed." The metamorphosis commences with the camera moving in for a closeup of Serafine's face, revealing startling changes. Animators altered the actress' real features, using 3-D effects applied with 2-D techniques to show human eyes morphing into slit-pupil animal eyes, and canine teeth enlarging and becoming sharp. As the camera travels down Serafine's body, her shirt tears open, revealing chest muscles and ribs expanding outward. "The body was actually a prosthetic piece created by Crawley Creatures that we did a 2-D warp on in the computer to make it bulge more and blend better with the rest of the transformation. We also added extra nipples and tracked them into the shot." As the camera continues moving down Serafine's body, her legs begin changing, adding



A savage battle between opposing werewolves required intricate choreography and complex interactive animation.

bulk and muscle mass — another digital effect. “Anthony wanted this sickening moment where you hear her bones wrenching and twisting. Then hock joints, that you associate with animals, snap back from the thighs so that Serafine is now standing like a dog, her legs bent back. At that point, we cut to our full CG werewolf, which falls forward and slams down to the ground on all fours, then stretches and begins to sniff around.”

A quicker transformation occurs when Andy, newly afflicted with the werewolf’s curse, jumps into a fountain as moonlight triggers the change. Then, moments later, in a burst of splashing water, he leaps out of the fountain a full-blown werewolf, dropping to all fours and shaking his wet fur like a dog. Lead technical director Ron Moreland used Dynamation and SBS’s custom hair render tools to create all the critical hair dynamics. “In this case,” noted Straus, “we were dealing not only with computer generated hair, but wet hair, with CG water dripping and spraying off of it. Plus, it was filmed slow motion; so the dynamics of it all had to be just right, because your eye really dwells on it.”

The fountain — a set piece built on a shooting stage the production had set up in an old steel mill in Luxembourg — managed to provide a practical effect that would integrate perfectly with the CG animation and additional interactive CG elements. “We wanted the scene to be a really surprising moment, showing how powerful a werewolf is,” Bruce Walters commented. “Harald Ruediger, our special effects guy, installed air cannons in the fountain and built a pump out of the front end of a BMW, some fire hoses, steam generators and all kinds of stuff. When he ran this setup at full speed it really got the water roiling. Then, at a certain moment, he triggered the two air cannons, which exploded water out of the fountain. By sheer coincidence, the shape of the water was almost exactly the shape of the werewolf.”

To sweeten the shot, the digital team enhanced the plate water with a CG water impact. “Since the werewolf is dripping and shaking off water,” Scott Gordon stated, “we thought it would be more realistic if we added real puddles and drips and splash elements; so our crew composited those in. We had to block out elements in the original plate with a clean plate underneath the CG paws so the water would seem to wrap around them.”

By far the greatest challenge for the animation team was a subsequent scene in which Serafine, in her bestial state, engages in a vicious fight to the death with one of the rogue werewolves. Although Straus’ previous experience animating dinosaurs for the T-rex-versus-raptor battle in *Jurassic Park* would prove invaluable, here he faced an even more difficult task — pitting two hairy, seven-foot-tall CG creations against each other with an unusually high degree of interactivity. “I just thought, ‘Oh my God, what have I gotten myself into?’ It is a massively time-consuming and frightening thing to have two CG creatures interacting. One is hard enough; but two interacting is four times harder, because as soon as one character does something, you have to animate the other character to react, then go back and animate the first character’s response, and so on. The level of work just compounds. Besides animating the two werewolves to roll on the ground, attack, bite and scratch each other, we had to choreograph all of that action to big, hand-held camera moves. With present-day software, that was not an easy thing to do.”

Straus looked to dog fights for inspiration in choreographing the complex battle scene, whose essential moves were planned out by the director. “We shot video of Anthony and a crew member

acting out the fight scene. They'd wrestle with each other and roll on the ground — it was a great way for the crew to work out their aggressions on the set. Of course, that was just a starting point. From there, we had to make sure that all the weight and timing and force was equal to that of a 700-pound creature with animal legs and so on." Animators also relied on their virtual cameras to make the performance believable. "The battling werewolves were going to be seen on film as a two-dimensional final render; but as the animator, I could watch the fight from any angle. It would be very difficult to animate if we were restricted to just the camera view we're matching to the background plate. By using multiple cameras in the computer to rotate the 3-D figures and peek at them from a variety of different angles, we could make sure everything was reacting realistically."

An important consideration in choreographing the fight was establishing a balance between animal movements and human ones. "The fight was so fast and furious, it was like two dogs trying to go at each other. So at one point, somebody suggested having one of the werewolves suddenly do something human, like throw a sucker punch. Anthony thought that was a great idea, so I found just the right moment. The two werewolves slam up against a wall, Serafine let's down her guard a little, and the other one clobbers her in the jaw."

After stealing a secret serum that gives him the ability to change into a werewolf at will, Claude injects himself and rampages through a subway car loaded with commuters. Lighting the creature and getting it to look right in the brightly lit surroundings proved trickier than in other scenes where the werewolves were mostly viewed in low light. Initial shots had the werewolf bursting through a cabin door, haloed by an explosion of smoky backlight. "We had to find a way to get the hair to look luminescent for that shot — which was tricky," recalled Straus. "Then, not only did we have to animate him in the context of a brightly lit subway car, with people running around in front of the camera, but we also had to composite his reflection onto all of the interior chrome surfaces."

As the serum wears off, Claude undergoes a reverse transformation back into human guise. Executed as a 3-D computer generated effect, the transformation again had to be accomplished within the context of a brightly lit subway car interior, in full view of the camera. "Anthony wanted the body to collapse inward," said Straus, "going from this giant, muscular, barrel chest to a more human form in stages, revealing the slow decrease in muscle mass. The overall creature was modeled in Alias and Viewpoint, but we used Softimage for the actual transformation — all the 3-D animation of the chest, legs, eyes and teeth. We ended up putting every effect we could think of into that sequence — we just threw the book at it."

Having killed the werewolf who infected him, Andy is cured of his lycanthropy and reunited with Serafine, who is likewise cured. The original ending, shot but subsequently excised from the film, had featured the happy couple, a year later, welcoming a new baby — whose eyes open slowly to reveal the slit-pupil eyes of a werewolf. Unhappy with that version, Disney president of production Joe Roth committed additional time and money toward a new ending. Since test audiences had responded well to the movie's opening bungee jump, it was decided to close the picture on a similar note, with the couple making another leap — this time off the Statue of Liberty. "Several long shots incorporated the real Statue of Liberty, with greenscreen footage of the actors on wire rigs tracked into the shots along with a digital bungee cord," explained Mark Wendell. "All closeups, however, were done with a CG Statue of Liberty and digitally matte painted base." Animators used a high-resolution model from Viewpoint for the shots, adding paint texture and details based on reference

photos provided by the production. “Like the Eiffel Tower sequence, we relied on digital animatics to plan the shots, but it took some pretty tricky compositing and fancy tracking and camera moves to make it all work.”

With character animation now on its resumé, Santa Barbara Studios considered itself fortunate to have found in Anthony Waller and Cometstone Pictures an alliance forged in trust, flexibility and a spirit of cooperation during the making of *An American Werewolf in Paris*. “It was a real partnership,” reflected John Grower. “This may have been the most challenging thing we’ve ever done, but working with Anthony and his production company made it a thoroughly enjoyable experience. In fact, I’ve never had more fun on a project in my nineteen years in the business. We all wanted to make the best movie possible for the amount of money and time that we had; and I think we not only did that, we surpassed everyone’s expectations.”

An American Werewolf in Paris photographs copyright © 1997 by Stonewood Communications and Hollywood Pictures Company. All rights reserved. Production still photography by Erich Francois. Additional photographs courtesy of Santa Barbara Studios. Special thanks to Diane Holland and Howard Green.

EVENT HORIZON STARSHIP HADES

ARTICLE BY KEVIN H. MARTIN

The device is standard science fiction fare. A starship's black-hole-powered gravity drive opens a gateway in the very fabric of space-time, allowing a craft to travel to distant stars instantaneously. But what happens when that starship's transition places it not in a neighboring solar system or galaxy, but within a realm of utter chaos? Such is the premise of *Event Horizon*, a science-fiction-horror hybrid, directed by Paul Anderson from a script by Philip Eisner.

When the *Event Horizon* — a prototype starship that vanished without a trace in the year 2040 — suddenly begins sending an emergency signal from the vicinity of the planet Neptune seven years later, a search and rescue mission is launched to investigate. Dealing out visceral shocks without ever having to reveal any hoary monsters from hell, the film focuses selectively on the subjective responses of the salvage crew as they confront an evil force now embodied in the vessel.

Having previously directed *Mortal Combat*, in which he demonstrated an eye for dynamic staging and a knack for dealing with effects work, Anderson was handed the directorial reigns on *Event Horizon* by producer Lawrence Gordon, who had acquired the script years earlier. When Paramount Pictures elected to develop it further, two London-based effects facilities — Computer Film Company and Cinesite — were brought onto the production under the guidance of visual effects supervisor Richard Yuricich. Already on board as effects supervisor for another Anderson film in development at Paramount — a science fiction story entitled *Soldier* — Yuricich had switched over to *Event Horizon* when the former project was shelved for a year because of scheduling conflicts. Peter Mitchel Rubin of Production Arts Digital and artist Daniel Slavin, who also had been at work on *Soldier*, followed Anderson to the new assignment, where Rubin was tasked with creating 3-D previsualizations and Slavin with developing some of the storyboards.

Given the latitude to act as both concept artist and designer during the previsualization process, Rubin developed geometries for the film's various spacecraft, then created and applied textures to the forms. For the look of the derelict ship, *Event Horizon*, Rubin scanned elements of Notre Dame Cathedral into the computer and manipulated them to produce both exterior and interior design motifs. "The idea was to depart from tradition and incorporate a gothic architectural aspect," noted Rubin. "Texturewise, the ship was originally to have had a built-from-stone look." For the U.S. Aerospace Command rescue ship *Lewis & Clark*, Rubin borrowed from NASA near-future designs. Another main ingredient was the deliberate incorporation of



*Among the miniatures built by David B. Sharp Productions for the Paul Anderson film, *Event Horizon*, was a large space station commissioned by visual effects supervisor Richard Yuricich.*

shapes evoking ambulances and helicopters — subliminal cues reinforcing the notion that the vessel was an emergency rescue unit.

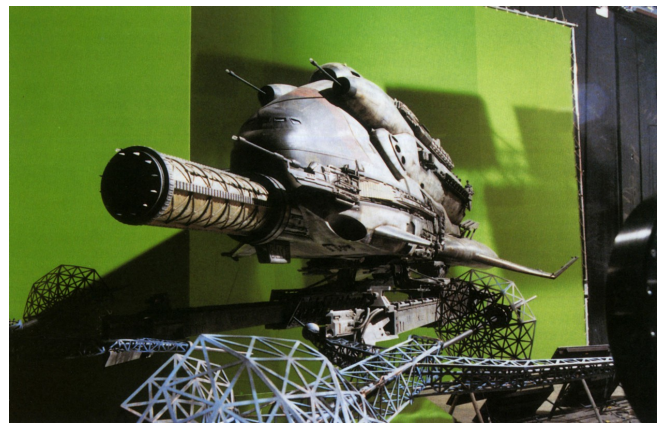
Though the production would be based in London, Yuricich engaged David B. Sharp Productions of Granada Hills to handle the extensive miniature work — which included the creation of twenty-seven models. Upon arriving in London, Sharp viewed one of Rubin's elaborate previsualizations — a pullback revealing the space station Daylight, seen orbiting above earth in the film's opening. "It was an important shot that had to establish outer space as the setting for the story," said Sharp. "But as originally conceived, it had some pretty intense moves and probably could not have been done with a model any smaller than half-scale — which would have made for a 500-foot-long miniature."

To test alternate moves and angles, Yuricich and Sharp had a 1/480-scale foamcore mockup of the space station built, then recorded various moves on it with a lipstick camera. "Starting with the basic framework of the station," Sharp stated, "we had to find a path that looked good while wending all the way back on a diagonal from the upper-rear corner of the model to the lower-front. We knew there was a dead area in which we could put nothing, since that physical space would be occupied by the camera. Even so, there was plenty of room on the sides of the frame for station structures — a small shuttle, oxygen generators, carbon dioxide scrubbers, satellite dishes and solar panels." Yuricich hit upon the notion of adding a revolve to the pullback. The revised shot would put the camera through 540 degrees of rotation before letting it come to rest at a scale distance calculated to be more than a half-mile from the station — the equivalent of a 2900-foot dolly move.

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The pullback begins with a shot of Dr. William Weir (Sam Neill) on board the Daylight, awakening suddenly from a nightmare about the lost ship, which he was responsible for designing. "We shot Neill live-action on stage with a sixty-five-foot dolly move," Yuricich recalled, "pulling back far enough from the set so as to eliminate perspective shift. Past a certain point in the shot, it wouldn't matter if the live-action element read as flat; so we knew that dollying more than forty feet would flatten the perspective into something we could use." The image of Neill was then nested into a window area on a quarter-scale partial model of the station. In turn, this was blended seamlessly with the full space station model. "Mark Nettleton at Cinesite London handled the transition between our large-scale pods and the hero space station," remarked Sharp. "I was just blown away at how well the blend between the two was achieved."

Sharp and his crew constructed the Daylight model — measuring roughly twelve feet by twelve feet — using epoxy-impregnated fiberglass material capable of providing the required tensile strength at minuscule thicknesses. "The one aspect of spacecraft miniatures that always proves troublesome is that the structural pieces get too thick. This happens because models are built and suspended in



The Lewis & Clark, dispatched to investigate the mysterious reappearance of the long-lost starship Event Horizon, is filmed on an enlarged section of the space station as it is prepped for departure.

gravity instead of zero-G. We tried to push the envelope this time, creating pieces which usually did not exceed an eighth of an inch in thickness.”

Employing a Ron Schmidt camera — the world’s smallest Vistavision unit, measuring just 4¼ inches in diameter — visual effects director of photography David Stewart had only just enough space to pull the camera safely back through the miniature. “The length of the shot was a factor,” Sharp noted, “as the Schmidt held only enough film for about thirty-five seconds of shooting. The pullback ultimately exceeded the amount of film, so we ended up rocking and rolling for a couple of frames at the end to extend it.” The miniature also had to be built and dressed to camera view. “Our Schmidt wormed its way between station modules and superstructure,” said Yuricich, “so the miniature had to be dressed with pods that were revealed only as the camera pulled back past them. They were art-directed and choreographed to appear in aesthetically pleasing areas of the frame, sometimes passing within inches of the camera body.”

Motion control supervisor Mark Weingartner supervised construction of the rig utilized for the pullback. “It was the dolly rig of a Gazelle motion control system, with a huge sixteen-foot boom arm attached,” explained Sharp. Complicating matters was the size of the stage which, a mere thirty feet in height, was insufficient to allow a diagonal camera pullback. Consequently, the pullback had to be executed as a straight, horizontal camera move, requiring that the model be tilted back some twenty degrees to give the impression of a tilt-down. “Visual effects art director Brent Boates drew up plans showing us just exactly how to hang the model in order to get the move to work on stage, while modelmaker Jim Machin supervised the actual rigging.” Sixty pieces of wire, each hooked to fishing reels, held the suspended Daylight miniature, allowing for minute positioning adjustments. “We let the model settle for a couple of days after first hanging it up, because with so many light passes required for backlighting and such, we couldn’t have any drift at all.”

The earth below was created by digital artist Michele Moen, an oil-trained matte painter who had apprenticed under Yuricich’s brother, Matthew, before expanding her repertoire to encompass the digital realm. Moen used NASA photos of earth as a basis for the Daylight space station background element. Referencing satellite photos, she also produced views of Neptune glimpsed throughout the show, modeling a dimensional weather system contoured to fit around the planet.

While the Lewis & Clark and Event Horizon were the only spaceships in the film, Sharp and his team fabricated a total of twenty-five distinct models of the two craft — in some instances detailing basic shapes provided by Mass. Illusions — as well as additional duplicate pieces for pyrotechnic sequences. All together, eleven different Lewis & Clark models were fashioned, ranging from a 1/240-scale, one-foot version — scaled to match the hero Event Horizon — to eighth- and sixteenth-scale partial pieces for closeup views of the ship’s docking claw and umbilicus. “The idea for the Lewis & Clark,” Sharp explained, “was to extrapolate the next generation of space shuttle. Our backstory had this class of spacecraft coming into existence around 2015 or 2020 as the new standard.” CAD files were created to facilitate milling and brass-etching for the Lewis & Clark, whereas the Event Horizon was built via more traditional modelmaking techniques, such as sculpting and cutting.

Shots featuring both spacecraft emphasized the size disparity between the two, with the Event Horizon looming large and gloomy, like some huge haunted house, contrasting with the smaller

Lewis & Clark in the foreground. Rendezvous maneuvers between the vessels utilized scale references to evoke an appropriate measure of awe and fear of the leviathan starship; but just how far Anderson's techno-gothic look could be taken was a matter of some discussion and, subsequently, revision. "After we shot the rough Event Horizon model," related Sharp, "Paul backed off a bit from the Notre Dame textures. We still had the same approach — where gargoyles appeared on the cathedrals we'd have our antenna dishes, and overall it kept that gothic look — but the color scheme and stone-like textures did change. At this point we installed hundreds of mini-Mag lights and fiber optics, along with other illumination sources. In all, we had more than three thousand practical lights on the model. Our model shop supervisor, Chris 'Flimzy' Howes, painted some model pieces with a slightly more traditional spacecraft color scheme. Then Dave Stewart shot them and Richard routed them back to Paul Anderson for his approval."

At 1/240-scale, the Event Horizon hero model measured an impressive 29½ feet in length. "It was the largest vehicular model I've ever worked on," declared Sharp. "Even so, it was absolutely necessary to go that big, considering how close we'd be getting in some shots. Despite all of the ultra-fine filigree work — including close to \$30,000 in etched brass pieces for that craft alone — there was no way to get away with working at a smaller scale." The miniature required three mounting points for each setup — one for the human containment section in the front, one for the second and third containment sections in the rear, and one for the center fuselage — containing the main corridor where the airlock and docking facility were located — which linked the other sections together. "Each time we had to move that model around, it took a couple of days, as well as chain hoists and forklifts. Fortunately, we had Flimzy around to devise all of our rigging setups." In all, fourteen miniatures, many of them partial sections created in eighth- and sixteenth-scale, were required to convey the size and scope of the starship.

In addition to an eighth-scale umbilicus miniature, a full-size interior section of the extendable docking passage was also built, measuring thirty feet in length. Since this linking tunnel between the two vessels would, in reality, occupy a physical space more than four times longer than the available shooting stage, Yuricich erected mirrors at one end of the set to convey the vastness of the passage, then added greenscreened space-suited figures before seaming the elements together with a Michele Moen matte painting.

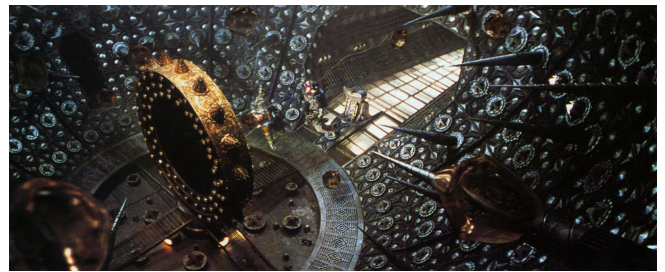
Portions of the Event Horizon were constructed full-size on stage, including a 140-foot-long set representing the craft's massive main corridor, which separated the crew section from the drive section. Yuricich and Weingartner — along with The Magic Camera Company — provided on-set motion control and plate photography, later augmenting shots of the passageway with miniatures, digitally composited to visually extend the corridor. In addition — for scenes of the rescue team searching the ship — Cinesite created an assortment of computer generated artifacts, seen drifting through the weightless environment and occasionally colliding with one another.



The full Event Horizon model, nearly thirty feet long, is photographed on a motion control stage at Pinewood Studios.

Globules of coolant floating through the ship interior were created by Computer Film Company. “We had just three to four months for the whole show,” recalled CFC senior producer Alison O’Brien, who oversaw the company’s slate of two hundred effects shots. “We escalated from four designers to a team of eight, just to accommodate the work.” While a number of CFC shots were 2-D, those featuring the coolant were not. “From a 3-D point of view, these floating masses were extremely challenging,” remarked senior CG animator Dominic Parker. “The coolant’s appearance in still form was fairly straightforward, since we had plenty of reference material, including footage from NASA and the Russians showing how water squirted out of hypodermics behaved in zero gravity. Unfortunately, in all of the reference material, the drops were small in frame; so we had to come up with an imaginative approach to achieve the tiny details of movement within our larger masses of coolant.”

Computer Film Company also provided video monitor burn-ins for interior spaceship scenes. Screens aboard both craft remained blank during live-action shooting, allowing flexibility in directorial choices as to style and content of imagery. In all, some 120 burn-ins were accomplished, twenty of which demanded articulate mattes and tracking. Among the most complex were shots of a tumbling laptop computer that required the insertion of an image into the stage prop’s screen throughout a full rotation cycle.



Globules of coolant — among the digital effects contributed by Computer Film Company — float weightlessly inside the derelict ship.

Exploring the drive section of the abandoned starship, engineer Justin (Jack Noseworthy) passes through a dizzying passage known as the first containment — a fifty-foot-long backlit rotating tube surrounding the passageway. Most of the Event Horizon interior sets continued the ship’s medieval architecture motif, with dimly-backlit arches and pillars. Production designer Joseph Bennett used particle accelerator interiors as a model for the ship’s various compartments, appropriating that plating style to evoke a feeling of medieval armor, while the metallic sheen and castings reinforced its high-tech aspect.

Passing through the second containment and into the third — a gateway shielding the ship’s artificial black hole power source — Justin is drawn through a suddenly permeable membrane at the containment’s core as it belches out a destructive energy wave that wreaks havoc aboard the Lewis & Clark. CFC senior designer Paddy Eason used deformation software to create the refractory waves seen bursting out from the containment.

With their own ship damaged, Captain Miller (Laurence Fishburne) orders his crew to board the Event Horizon until repairs can be made. Justin’s troubles continue, however, as he enters an airlock without his space suit, acting under an unknown, presumably demonic influence. Outside the Lewis & Clark making repairs, Miller propels himself down the length of the Event Horizon’s fuselage section in an attempt to rescue his comrade. Live-action footage of Fishburne — shot greenscreen on a partial set featuring full-size fuselage elements — was composited into a 1/72-scale corresponding model section. Dubbed ‘Miller’s Crossing’ by the crew, the suspenseful sequence

required perceptual gymnastics and a degree of mechanical ingenuity to insert the live-action into an appropriate background plate. “Miller is supposed to cover several hundred feet during a series of shots,” Yuricich explained, “so we had to scale down the live-action motion control move to stage matching action in a corresponding section of the fuselage miniature.”

In one shot, however, this scaling-down process stalled. “We had a rather elaborate camera move as Miller zooms up from the distance and does a close flyby before whipping off,” Yuricich explained. “The Gazelle motion control arm took an inverted camera through a 165-degree move.

Unfortunately, the interior of the fuselage section — an area between five corridors that spanned the crew and drive sections of the Event Horizon — was just too tiny on the model to allow even the Schmidt camera to duplicate the move. Much as we hated to do it, the model had to be cut in half to give the camera the necessary headroom. Dave Stewart wound up shooting the fuselage interior halves in two separate passes, which CFC blended together for us, and the live-action went in on top of that.”

Tackling Justin, Miller hauls him back into the airlock, saving the man’s life. Blood drops erupting from the engineer’s vacuum-damaged eyes were created at CFC and composited digitally with the live-action. As repairs to the Lewis & Clark near completion, the crew prepares to reboard the vessel. Medical technician Peters (Kathleen Quinlan), however, tricked by ship-induced visions that her son is aboard the Event Horizon, plunges to her death, falling several stories into the second containment. CFC employed a cyberscan to map Quinlan’s face onto a dummy used in shooting the fall. In a later sequence, Weir succumbs to hellish hallucinations of his wife’s suicide, blinding himself in both eyes. To depict the results of the mutilation, Sam Neill wore appliance makeup fashioned by Animated Extras — which, together with Image Animation, supplied effects makeup for the production under the supervision of prosthetics coordinator Joseph Ross. Target markings sculpted into the appliances allowed Cinesite to track the shots and add a computer generated model of eyeless sockets.

D.J. (Jason Isaacs), the first crew member to fall prey to the now-possessed Weir, ends up eviscerated by the doctor in a gruesome sequence that featured appliance work by Image Animation. The deranged scientist subsequently plants and detonates an explosive charge aboard the Lewis & Clark. “I had never done pyro on anything smaller than twelfth or sixteenth scale,” allowed Sharp, “so these 1/72-scale models really worried me. How we were going to get these things to come apart credibly, even shooting at 360 frames per second, was always on my mind. We had already developed methods to get tremendous detail; but with the explosion shots we needed the feel of a big blast, with debris that maintained that scale.” Upon consulting pyrotechnics veteran Joseph Viskocil — a longtime friend — who lent his expertise and his sequencing box to the production, Yuricich and Sharp executed the blasts successfully by inverting both miniature and camera to allow gravity to enhance the effect.

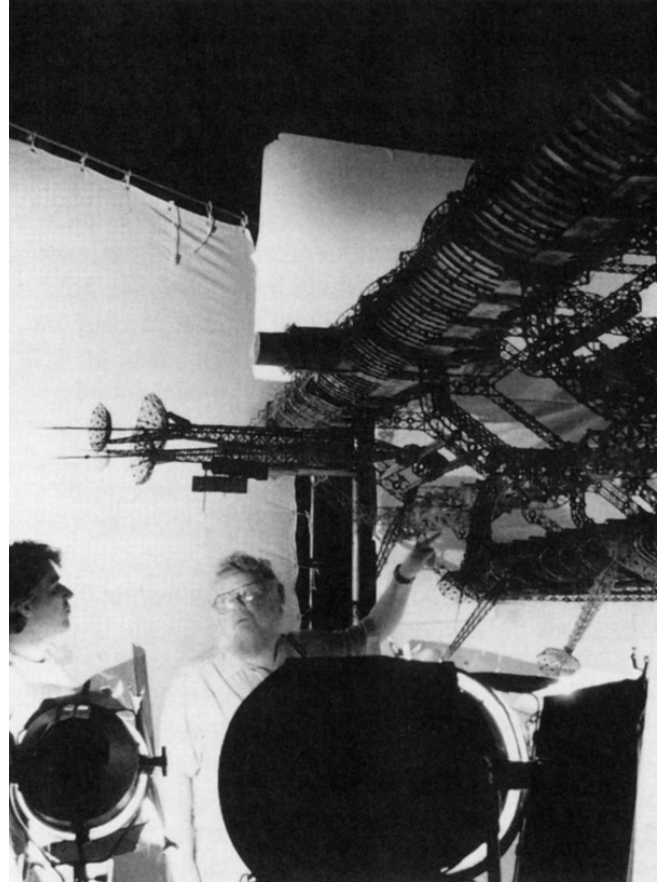
A sixteenth-scale Lewis & Clark model was also blown apart, using mortars and primacord. “Our breakaway pieces were done with pewter sheeting — which is often used in England,” explained Sharp. “Americans generally prefer lead. I have used soft aluminum sheeting for years, but this pewter was so wonderful that I switched over. It has the same kind of texture you find on foil wrapped around the top of a champagne bottle — but it isn’t as heavy or dangerous as lead, and you don’t need to observe all the cleanliness and safety precautions.” Terry Schubert and Tim

Stracey pre-rigged primacord in baskets filled with blackwrap and pewter. Lit by strobes synced to the high-speed camera, the explosion also featured black cornflake debris.

To achieve the ultra-fine fragmentation of the ship, hundreds of two-inch pewter panels were individually hand-glued into a female fiberglass mold. “We pressed a male mold into that, turned it over and removed the female mold, leaving the outside of the skin visible. We painted and puttied that, then reinserted it into the female mold, popped off the male mold, set the female on a structure and pulled that mold away, too. At that point, we had a finely-detailed, incredibly flimsy pewter-paneled piece that was camera-ready.” Filmed explosions were later manipulated and pasted in 2-D over different parts of the ship. For a reaction shot of Miller staring out of an airlock window at the twisted remains of his vessel, a partial set of the wreckage was digitally extended and expanded.

Outside the ship at the time of its explosion, a space-suited Cooper (Richard T. Jones) winds up clinging to a spinning remnant of the wrecked hull. Resourcefully, the rescue specialist improvises his own rescue, venting his air tank and using the escaping gas to propel him back to the Event Horizon. The full-sized hull piece, dubbed ‘Cooper’s Chunk,’ was a lucky find by set dressers. “They went to an aircraft boneyard in Bournemouth, England,” Sharp recalled, “and found a big section of a Lockheed Tristar being cut up for scrap. Art director Malcolm Middleton, Richard Yuricich and I took a good long look at the Lewis & Clark and settled on a section which, scaled up, looked quite a bit like this hunk of plane. We adapted the aircraft piece a bit, then built an eighth-scale duplicate to intercut with the Tristar.”

Intent on killing Miller, Weir inadvertently de-pressurizes the ship’s bridge, causing a canister to carom through the structure before bursting out of the viewport window, sucking Weir into the void. Yuricich instructed floor effects supervisor Neil Corbould to arrange a series of precisely timed spark gags, augmented by wire-rigged debris pulls to cue the movements of the canister — which was later computer generated and inserted into the shot — and then arranged with cinematographer Adrian Biddle to have the plate shot undercranked at one-third to one-half speed. “In transitioning from the live-action set to the miniature,” Yuricich observed, “we went from flying the camera through an eight-foot window to a really tight pullback from a three-quarter-inch miniature window. A sense of tremendous velocity coupled with erratic movement helped cover this somewhat, though we still had to go in and digitally paint some additional detail to help blend the two shots.”



Effects director of photography David Stewart prepares to shoot an enlarged section of the Event Horizon’s center fuselage.

In a race against time, Miller sets explosive charges with the intention of separating the crew section of the Event Horizon from its drive section — providing surviving crew members with a means of escape. However, Miller, too, falls prey to the evil on board the ghost ship. Pursued by a fiery apparition from his own past — a former crew member he had failed to save — he runs down the drive section's narrow passageway, above the spinning first containment. To film the flight, Yuricich had a light rigged on a dolly. "We could roll it closely behind Laurence Fishburne as he ran, and it supplied the necessary level of interactive illumination, suggesting that a great lick of flame was closing in on him. In post, we took a flame element and laid that in twice, over the on-set light rig." The burning apparition was created through multiple passes — some motion control — shot on stage using a puppeteered body built by Image Animation. Swathed in fabric and burned in sections, the puppet body was later blended with separately shot footage of actor Noah Huntley in burn makeup.

Its containments ablaze with the fires of hell, the Event Horizon prepares to depart with its newly captured souls. But the explosives Miller has set in the fuselage detonate, destroying the vessel's midsection. Again, Sharp had to produce finely detailed debris. "After a bit of experimenting, we wound up laser-cutting card pieces — the thickness of business cards — to create a representation of the hull that was incredibly flimsy. It was tacked together using cyanoacrylate glue, then hung from a group of wires like the space station. The fuselage sections, rigged with primacord, were suspended from huge rolling steel frames which we could roll in and out of the stage." The explosion frees the forward crew section, allowing the survivors to make good their escape just moments before the drive section disappears into a black hole above Neptune.

Distinguishing itself from most modern-day space films, Event Horizon would offer a new twist on the genre, substituting slimy aliens with its own brand of metaphysical horrors and psychological terrors. "In the beginning," Richard Yuricich noted, "I was attracted to this project for the challenge of portraying zero-gravity in as realistic a fashion as we'd seen in *Apollo 13*. But by the time we'd gotten the necessary rigs designed and assembled, most of the weightless scenes had been dropped. Rather than be disappointed by that loss, we instead wound up facing and accepting different challenges — of which there were many. I think we rose to these new challenges — and in doing that, were able to help Paul Anderson make a genuinely scary movie."

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BOSS FILM STUDIOS END OF AN ERA

ARTICLE BY MARK COTTA VAZ

The end was foreshadowed — as appropriate in the computer age — by an interoffice e-mail transmission from Richard Edlund, founder and head of Boss Film Studios. The message, announcing a late-afternoon meeting — subject unspecified — took model shop supervisor Dave Jones by surprise. “It made you think, “What’s going on here?”” recalled Jones. “I think the worst-case scenario in everybody’s mind was that some of us would be asked to take some time off.”

Right up to that fateful meeting, when Edlund announced the closing of his company, he had been working on deals to save the fourteen-year-old enterprise. “We were trying to put a deal together up until an hour before the announcement was made,” Edlund revealed. “For months we had been talking to the studios, who had all soured on the idea of setting up in-house services. Other possible deals would have linked us with a post facility and kept our 3-D artists at Boss. Several scenarios, involving mergers with other companies, looked good. But all of these various deals had lots of moving parts, which take a long time to put together — and some of the moving parts got sand in the gears.”

The official announcement — released publicly on August 26, 1997 — brought the curtain down on one of the oldest and most distinguished of the film industry’s few remaining full-service, independent effects facilities. Edlund had founded his powerhouse company in 1983, charging out of the gate with *Ghostbusters* and *2010*, both of which earned Academy Award nominations in visual effects — the first of seven to be garnered over the years. From that auspicious beginning, Boss had established a high standard for artistic and technical innovation in its film and commercial work, spanning both traditional photochemical-based optical effects and the high-tech aesthetic of the digital age.

The Boss closing was not the first casualty in an industry reeling from rapid growth and technological advances. In 1993, Apogee had closed its doors, followed by Stetson Visual Services in 1995. More recently, Warner Brothers pulled the plug on its Warner Digital Studio after a short run, even as the fledgling in-house operation was finishing postproduction work on *Batman & Robin*. Other formidable players — such as Digital Domain, Rhythm & Hues and Sony Pictures Imageworks — reacted to market vicissitudes with significant downsizing.

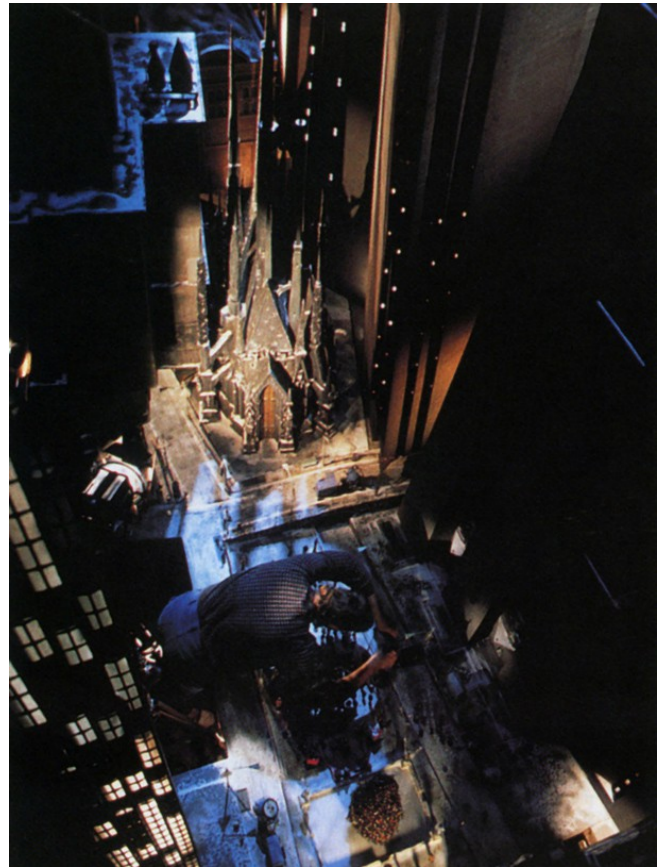
But Boss Film employees could be forgiven for assuming their future was secure. The very day Edlund assembled his staff to deliver the bad news, a company trailer equipped with electronics and digital compositing gear was on the road to Northern California to shoot plates for Disney’s remake of *The Parent Trap*. “Unfortunately,” said Edlund, “*Parent Trap* wasn’t the high-ticket project we needed to stay afloat. Timing was a critical factor. While we had just finished *Air Force One* and a major sequence for *Starship Troopers*, we had no big followup show. We needed a cash flow of \$15 million a year, without breaks. If you have a break, you have to gamble your profit from your last show —



Recently disbanded after a fourteen-year run was Boss Film Studios, one of the last of the full-service independent effects houses. On stage at the studio, the Stay-Puft marshmallow man lumbers through New York in *Ghostbusters*, the first film to feature effects by Boss.

however slim it might be — and stretch it out until the next. Meanwhile, with ninety people on staff, the burn rate is around \$40,000 a day. Being an independent is a significant burden; and without a guaranteed income, it's a crapshoot. Finally, I just decided I wasn't going to go for the gamble."

Another squeeze was in the demands of a digital age. But while those costs were considerable — as opined in a September New York Times article which speculated that Boss' fate was sealed in 1993 when it expanded its multi-million-dollar photochemical infrastructure to invest millions more in newfangled digital equipment — the situation was exacerbated by competitive tensions between rival houses. "With the digital revolution came the ability to set up a company relatively quickly," Edlund noted. "It became easy to go to Silicon Graphics, plunk down a few million for workstations and software, then hire your guys. In the old days, when we built optical printers and had people adept at using them, the playing field was more level. All of a sudden I was in the position of bidding against companies I'd never heard of — who didn't care if they lost money, and would underbid. On one project, we were underbid a million dollars by a company that had just gone public and could afford to take a million-dollar hit to get something on their reel. But those companies will probably feel the bite of the sword before long, too."



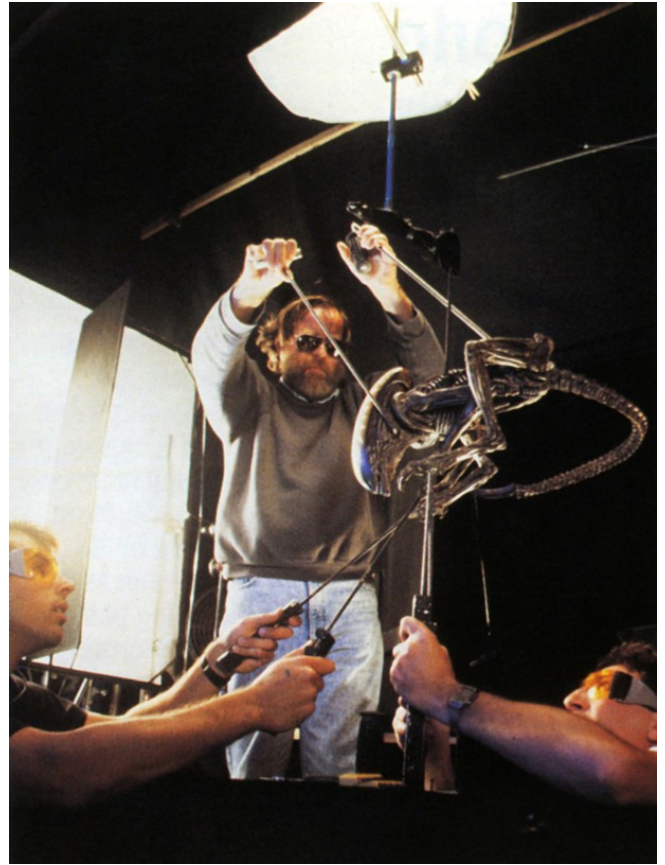
A large-scale miniature of Gotham City was built at Boss as part of the effects assignment for Batman Returns.

Although Edlund laments the in-fighting that often occurred among rival outfits battling for a bid, Boss veteran Neil Krepela — who is presently supervising the visual effects on Disney’s CG/live-action feature *Dinosaur* — does not spare the studios or producers either. “They were pretty vicious about pitting companies against each other,” remarked Krepela. “What we tried not to do at Boss was quibble about overages. But in the long run, after you’d bid and rebid and lowered your price, you had to take stuff out. That process was always difficult. I think the smarter studios realized they could beat down the effects companies to where they were basically asking for no money because they just wanted the work. But if you just made the rent and salaries, you couldn’t improve your R&D or your equipment. That caused houses like Apogee to fall by the wayside.”

The demise of a company means not just the sundering of a creative community, but the dismantling of a physical plant. Boss’ entire history had played itself out in an industrial building in Marina del Rey. Previously, the building had been home to Entertainment Effects Group — founded by Douglas Trumbull and Richard Yuricich — whose credits ranged from the first *Star Trek* feature to *Blade Runner* and Trumbull’s own directorial effort, *Brainstorm*. At the time, Edlund had been enjoying an illustrious career at Industrial Light & Magic, tackling supervisory roles on such film classics as *The Empire Strikes Back*, *Return of the Jedi* and *Raiders of the Lost Ark*, and earning four Oscars in the process. But after helping George Lucas relocate his effects facility from Southern California to Marin County after *Star Wars*, Edlund pined for a return to Los Angeles. While Lucas coveted his independence from Hollywood — both spiritually and geographically — Edlund likened his tenure in Marin to a stint in the Foreign Legion.

Synchronous with Edlund’s decision to leave ILM was Trumbull’s own decision to pursue directing and other personal goals. Entering into a pact with the EEG principals to take over their facility, Edlund began organizing his own company under the Boss Film Corporation banner. Krepela, a former ILM matte photographer, would follow him south to head up Boss’ matte department. “Richard and I walked through the facility before we’d even landed a film,” Krepela recalled. “At the time, half of it was occupied by a dental lab, and the model shop was around the corner in a separate structure. The place was in disarray, plus the roof leaked and one of the stages sat in an inch of water. But we felt we could make it work, and we started mapping out in our minds what the place would be like.”

Edlund was no stranger to getting such a venture up and running. Besides helping set up the ILM facility in Marin County, he had earlier played a key role in transforming a 30,000-square-foot Van



Boss puppeteers articulate a rod-puppet alien warrior created for *Alien3*.

Nuys warehouse into the effects house responsible for the seminal work on *Star Wars*. In the process, he had also helped resurrect the old wide-screen Vistavision format, which ultimately became a standard throughout the industry following the phenomenal success of that film. Ironically, after scouring the backlots and warehouses of Hollywood for abandoned or unused Vistavision cameras and printers, and championing their use in *Star Wars*, Edlund would adopt EEG's in-house 65mm format for his own company. "Richard thought Vistavision was a great format," Krepela related, "but all the equipment at EEG was geared to shooting elements in 65mm and then producing a 35mm composite negative. With the 65mm format, the film travels vertically through the camera — as opposed to horizontally with Vistavision, which has always been kind of a troublesome format to keep steady. Plus 65mm gives you double the negative area. So while Vistavision was good, with 65mm we had a format that was more stable and provided a larger film space. We ended up using it on just about every film, right up to *Cliffhanger*."

Boss also inherited from Trumbull such unique equipment as a computerized multiplane system — nicknamed Compsy — an animation rig which Krepela helped refashion into a matte camera. On *Ghostbusters*, the adopted Compsy would come in handy for many of the comedy's ghostly effects — notably scenes featuring the slobbering 'Onion-head' ghost that skitted about frenetically. Compsy allowed Krepela to take static Onionhead elements — shot with a suited performer on a black-shrouded stage — and rephotograph them, manipulating the images to provide the frenzied movements that the production desired.

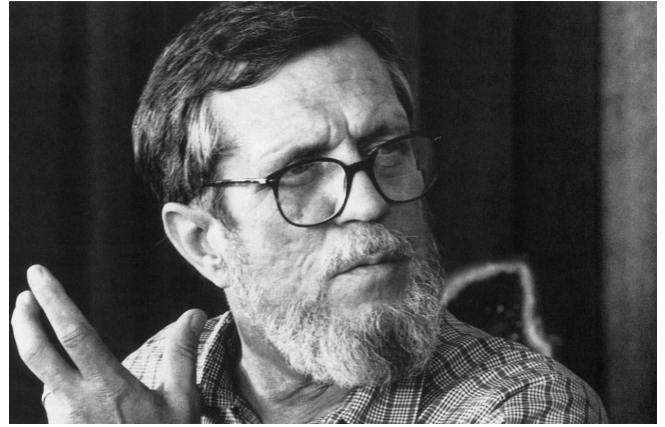
The start-up company wasted no time developing its own prototype cameras and printers as well. For *Ghostbusters*, Boss created its so-called Super Printer — built in a whirlwind seven months — and in 1985, augmented it with the Zoom Aerial Printer, or ZAP Both 70mm printers — utilized in tandem — boasted the telecentric lenses that Edlund, working with optical engineer David Grafton, had devised for the 'Empire' Vistavision cameras and the Quad optical printer during production on *The Empire Strikes Back*. "Telecentrics was a crucial development in composite photography," Edlund observed. "There had always been a problem with compositing mattes, in that they would enlarge when you went in and out of focus. But I had read a multi-volume series of books on applied optics — written by Rudolph Kingslake, the chief optical designer for Kodak — and in one of those books was something about an optical system developed for submarine periscopes. That was the key."

"Telecentric optics basically keep the optical path coherent so that images travel as a linear bundle instead of coming down to a point of focus and spreading out," explained Krepela. "The advantage of this for our printers was that we could defocus the back printer without changing the image size. Normally, even when you look at an object through a still camera, it'll change size as you go in and out of focus. Telecentric optics enabled our optical department to put a holdout matte in the back head and carry the color separation or interpositive in the front head, and you could soften the matte so its edges wouldn't give the composite a cut-out quality. It would also reduce the grain in the matte. It was a very powerful tool for visual effects."

From the beginning, Edlund had a clear company philosophy advocating that it was better to focus in on a particular show than a huge slate of movies. "We were big enough that we could handle just about anything, but we tried to keep a small company flavor," remarked Krepela. "We also tried to use the best technique for any given shot. Just because we had incredibly fine optical printers didn't

mean we'd do everything bluescreen. We'd shoot miniatures or rear projection or get it all in-camera, if that was the best way to do it."

As the Boss filmography grew — from effects-laden fantasies like *Poltergeist II* to hard-driving action fare such as *Die Hard* — the company continually sought to add new wrinkles to its game. On *Big Trouble in Little China*, Boss showcased unique animation effects in the character of an evil magician and his mystical minions, whose entrances were accompanied by a blast of green vaporous light and whose fingertips shot bolts of crackling electrical energy. Instead of using bottomlit animation, as was typical at the time, Boss animators hand-drew toplit art. And while traditional animation effects entailed shooting black-and-white art on black-and-white film, with optical departments adding color diffusion when compositing the elements into the scene, the Boss team inked the lightning art using white ink on black, diffused it and added a separate blue airbrush pass.



*Boss Film Studios founder Richard Edlund — a four-time Academy Award-winning visual effects artist — on the set of *Multiplicity*, one of the last big projects undertaken by the facility.*

Boss also won kudos for its commercial work, one highlight being a United Airlines spot featuring killer whales swimming inside a 747 to illustrate the jetliner's wide-body comfort. Aired during the opening ceremonies of the 1992 winter Olympics, it was the kind of quirky assignment that posed unique creative and technological challenges. "I think the other bidding companies suggested shooting the whales separately and compositing them into the plane interior," recalled Dave Jones. "Richard, of course, said, 'No!' That approach wasn't going to look real. You had to physically have the whales in the interior to integrate them into the ship, through subtle things like shadows and ambient light kicking off the seats onto the whales." To accomplish the effect, modelmakers built a third-scale 747 miniature with aisle slots to facilitate mounts for two cable-actuated animatronic whales. The illusion of a watery interior was achieved by employing a traditional dry-for-wet approach with smoke effects, enhanced by new CGI technology which added floating particulate matter. "It was a fairly outlandish concept, but visually quite striking — and it looked authentic. People didn't question what they were seeing. Comments received by United ranged from, 'How did you get those real whales to do that?' to 'Does the SPCA know you're doing this?'"

Further Boss innovations were forthcoming on *Alien3*, director David Fincher's 1992 feature debut, in which the quick-striking, on-the-loose predator once again wreaks havoc among its human prey. While alien shots would be created utilizing a third-scale rod puppet, the assignment's compositing challenges were aided by in-house development of a motion control field recorder dolly system, used to shoot live-action plates on set in England. The camera system could record data files for all on-set camera moves — pans, tilts, booms — allowing the Boss team to duplicate those moves, or reprogram and alter them as necessary, scaled to the bluescreen animation of the puppet.

Batman Returns, also released in 1992, proved to be one of the more interesting transitional features headed up by Boss during the twilight era of photochemically-based effects. This second *Batman*

installment had its share of innovations, too — notably in the extensive miniatures work requiring the model shop to create Gotham skyline views that matched the skewed perspective of a full-scale set on a Warner Brothers soundstage. For a high-speed vertical rise on a miniature building, Boss crews engineered a vertical motion control rig that Krepela likened to standing a motion control track on its end.

Batman Returns was also a harbinger of things to come, utilizing computer animation to depict swarms of flapping bats and an army of waddling penguins. Within a year, spurred by the release of *Jurassic Park*, the digital age would take hold of the movie-going public's imagination like no other effects innovation. Edlund greeted the dawn of the digital era with something akin to relief. "By the early nineties, I was so frustrated by the limitations of what could be done photochemically that I was thinking of getting out of the business," Edlund admitted. "I had been butting my head up against the wall of what was possible using photochemical techniques for a long time — this rancorous, unwilling technology. You had to trick the photographic process to come up with the shot you needed. Even dealing with matte lines was not a simple thing. There was the utter impossibility of doing anything with a shot if a composite element was unsteady. Then you'd have to deal with the wedging of images to get color balance of all the elements. Over the years, we had dealt with these and other issues as a matter of course. Our in-house engineering, machinery, electronics and software departments had developed the technology to do these things. We had the best optical printers ever built — and it still wasn't enough."

One project that would help propel Boss into the digital era was *Cliffhanger*, a 1993 mountain-climbing extravaganza. To create daredevil shots of actor Sylvester Stallone navigating sheer cliffs, Edlund again employed the vertical elevator rig camera setup built for *Batman Returns*. However, the *Cliffhanger* sequences would go far beyond mere miniature set work, with a Boss location crew hoisting photographic equipment by helicopter to precarious location sites in the mountain ranges of Italy. "We took seventy feet of our motion control rig," said Krepela, who co-supervised effects on the show with John Bruno, "and hung it from the sides of cliffs 600 to 1000 feet in the air, so we could get vertical moves and later composite Stallone into backgrounds that were far too dangerous for live-action shooting. We had to attach the rig with one-inch steel bolts drilled three feet into solid rock. It took a month to set up and a day to shoot."

In contrast to Boss' perilous plate work, the *Cliffhanger* optical composites were anticipated as photochemical business-as-usual. But digital methodologies — which in the past had been problematic — seemingly overnight had advanced to a level unanticipated mere months before. "On *Batman Returns*, we'd had to persuade Warner Brothers to let us do a digital composite," commented Krepela. "On *Cliffhanger*, we proposed doing about seventy percent of the composites optically, with the remaining thirty percent being done digitally. But between our bid and the time we had to put our shots together, these very powerful computers and off-the-shelf graphics packages had become available. By the time we finished *Cliffhanger*, our composite ratio was exactly the opposite of what we'd proposed. That's how quickly digital technology came into play."

Such rapid advances would take practitioners by surprise. "All of a sudden, it was as if we went from being blacksmiths to neurosurgeons," Edlund recalled. "When you can address every single pixel in an image, you have ultimate control over what you are doing. *Cliffhanger* was the last show for which we did an optical composite — there's been a coat of dust on our optical printers ever since."

In an effort to keep up with the digital revolution, Boss turned to outside revenue sources, bringing in an investor partner and setting up an electronic games division. “However, when you move into digital, you wind up in this morass of getting digital equipment — new hardware and software — and the necessity of amortizing this extremely expensive equipment over a short period of time.”

Nonetheless, Boss committed wholeheartedly to the new technology, expanding the boundaries of such fledgling methodologies as motion capture with the development of real-time motion capture puppetry for the alien annihilator in the 1995 science fiction horror movie *Species*. Among Edlund’s personal favorites in the digital era was the 1996 comedy *Multiplicity* — the ultimate split-screen endeavor — requiring Boss to make actor Michael Keaton into four cloned characters. Using the field recorder technology developed for *Alien3*, Edlund was able to film live-action moves and repeat them as Keaton played each successive role in a scene. “*Multiplicity* simply wouldn’t have been done during the traditional effects era,” observed Edlund. “The restrictions would have been too great. Photochemically, you could not have gotten away with traveling splits going across complex backgrounds. Although it was primarily a digital composite show, it also required a high level of filmmaking trickery. But with the digital tools we had, I felt much more liberated than on any previous movie.”

With the closure of Boss Film Studios, ending a fourteen-year run that spanned some thirty-three features, Edlund is experiencing liberation of a different sort. “While there’s sadness about closing down the company,” noted Edlund, his thoughts turning to former colleagues and employees, now scattered, “at times it was a real cross to bear. But we were lucky over the years. We did a lot of fine work.” Survived by only a handful of still-viable, full-service competitors, Edlund predicts a move away from the classic model of an independent effects facility — with permanent address, regular staff and technological infrastructure — to a new order where smaller-scaled, specialized operations spring up for specific projects, where studios rent stage space and equipment, and assemble freelance crews. “Effects work will be set up the same way you set up a movie — you hire a production designer and a cameraman for the duration of a production; and when the picture is done, they’re off and on to the next one. I think visual effects have become that flexible.”

BUG BYTES

image

ARTICLE BY
PAUL M. SAMMON

It all began with bugs.

In 1991, producer Jon Davison was approached with a project named *Outpost 7*, written by Edward Neumeier, a scenarist who had previously co-written and co-produced Davison's 1987 action hit, *RoboCop*. Set in the far future, and concerned with soldiers stranded on a remote planet whose indigenous population is composed of large, hostile insects, *Outpost 7* had been conceived as a *World War II* movie in outer space. The producer encouraged Neumeier to develop his initial concept into a full-blown treatment, which was subsequently submitted to TriStar Pictures — and turned down.

It was at that point that Robert A. Heinlein's classic science fiction novel, *Starship Troopers*, entered the picture. "Starship Troopers had giant bugs in it," stated Davison, "and we wanted those bugs. So we inquired about optioning Heinlein's novel, and discovered that it was still available. Ed and I immediately went back to TriStar and said, 'We want to make *Starship Troopers*.'" This time, the studio was more amenable. The end result was a firm development deal, with TriStar optioning Heinlein's novel, and Neumeier and Davison signing on as screenwriter and producer, respectively.

Published in 1959, *Starship Troopers*, on its surface, championed such traditional American values as hard work, moral responsibility and self-sacrifice. At the same time, through its storyline — which followed the basic training and eventual combat experiences of one Juan Rico — it emerged as a celebration of the military mindset and the common ground soldier. Indeed, so strong were *Starship Troopers*' quasi-reactionary politics, its author stood accused, in some quarters, of writing a fascist tract.



Director Paul Verhoeven and a host of effects artisans explored entomological warfare in *Starship Troopers*, a high-octane action film based on the classic Robert A. Heinlein novel. The cast included Casper Van Dien as Johnny Rico, who, through his combat experiences, transforms from an idealistic student to a tougher-but-wiser trooper. After a teaser opening, the futuristic film flashes back to Rico's final days at school, where, in a biology class, he dissects a giant bug — an Arkellian sand beetle, designed and built by Amalgamated Dynamics Incorporated. Verhoeven instructs Van Dien in the handling of a laser dissecting tool prior to shooting.



After enlisting for federal service, Rico receives basic training at Camp Currie. In one boot camp exercise, the mobile infantry trainees engage in 'laser tag' combat simulation. To represent the laser fire, backlit cel animation was rendered by Harry Moreau at Visual Concept Engineering, then scanned and tracked to the live-

action. VCE was just one of a dozen effects facilities that contributed crucial elements to *Starship Troopers*.

However, it was the novel's giant insects, not its themes, that made it an exciting movie prospect.

Convinced that, even with the bugs, no viable

cinematic treatment could be realized without an A-list director at the helm, Davison approached RoboCop director Paul Verhoeven regarding the project. Verhoeven was, initially, wary. "My first reaction was — 'Giant bugs? How silly,'" Verhoeven reflected. "Ed and Jon insisted that this film could be something special. But at the beginning, I was somewhat skeptical." With time, however, the director's viewpoint changed, and he began to warm to the idea. "I'd always wanted to do a movie about the Second World War, because I think it is an extremely interesting period. And since I'd experienced the Nazi occupation of my homeland when I was a boy, the concept also had personal connections. *Starship Troopers* seemed to be an opportunity to explore that period in an unusual way, and to translate my feelings about it into a science fiction framework." But what committed Verhoeven to *Starship Troopers*, more than any other consideration, was the prospect of working again with Phil Tippett, the stop-motion master who had contributed major effects to RoboCop, and the man Davison intended to entrust with the creation of *Starship Troopers'* bugs. "I'd found our relationship on RoboCop very stimulating. Phil's a genius-type guy, and ever since RoboCop, I'd been looking for another project to work on with him."

Introduced to the *Starship Troopers* project in 1993, Tippett saw in it an opportunity to further develop the computer animation techniques his Tippett Studio team had initiated for *Jurassic Park*. "Prior to *Jurassic Park*," noted Tippett, "I'd produced stop-motion mostly through traditional methods — by incrementally moving and photographing three-dimensional puppets on a frame-by-frame basis. But our studio's dinosaurs for *Jurassic Park* were not created traditionally. Instead, a special piece of equipment, the Digital Input Device, was developed for that picture by a talented guy named Craig Hayes. The DID is a metal puppet armature, rigged with electronic sensors. The sensors record movement information on a controller box that translates it for computer use. When an animator moves the armature by hand, those movements are mimicked by wire-frame representations inside a digital environment." As spectacular as *Jurassic Park's* CG effects were, Tippett had always felt that there was room for improvement. "The software, the hardware, the time it took to render images — all of that needed refinement. So when Jon Davison approached me about doing *Starship Troopers*, I realized this might be the moment to begin that refinement."

Before any actual animation was initiated, the filmmakers embarked upon an intensive design process for the giant bugs, which had been only vaguely described in the Heinlein novel. "Heinlein described them as looking like spiders," Neumeier said, "and yet the bugs seemed to have evolved physically beyond that because they were able to shoot guns and to behave in an anthropomorphic way. This was one of the earliest things Paul Verhoeven and I talked about; and it became clear that our discussions were leading down the path of anthropomorphic aliens, portrayed by actors in elaborate costumes. Verhoeven quickly put a stop to that line of thinking. He told me, 'I can't see a bug holding a gun.' He did not want to see some sort of man in a suit with a funny crab claw, or a six-foot-tall ant with its head in a space helmet. Eventually, we came up with the idea that we should do the bugs as bugs, as believable giant insects." With the insects stripped of their hardware, Verhoeven proposed that *Starship Troopers'* bugs would, like their real-life counterparts, defend themselves biologically, using their own bodies — claws, pinchers and emissions — as weapons.

Though he would remain involved, Tippetts essentially turned over the design chores to visual effects supervisor Craig Hayes so that he could concentrate more fully on animation and performance issues. Together, Hayes and Verhoeven began to map out the look of the bugs, reviewing nature film footage and studying the biological architecture and defense mechanisms of ants, mantises, beetles and various other insects. “Since these bugs were supposed to be intelligent,” Hayes commented, “or, at least, a whole lot smarter than our homegrown variety, we posited that a hierarchical structure would have evolved within the alien community, mimicking the division of labor seen among insects on earth — workers, drones, et cetera. Also, to follow up on the ‘World War II in space’ idea, we invented a sort of military analog for the bug troops. Some would act as foot soldiers, some as heavy artillery.”

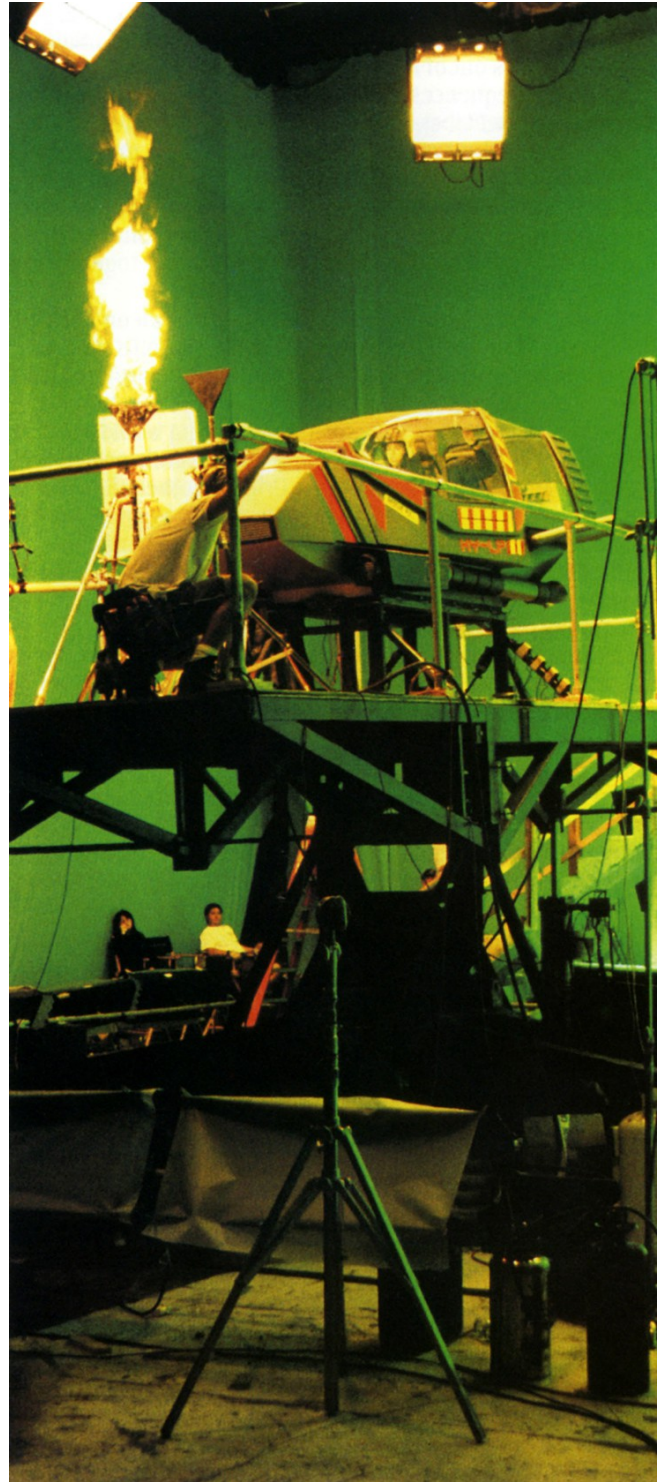
Dozens of hypothetical bugs were designed and considered before Hayes and Verhoeven settled on a total of six alien insects, each of which would perform a specific combat function. “The one bug we decided you would probably see the most of in *Starship Troopers*,” said Hayes, “was what we called a warrior — an eight-to-ten-foot-tall insect infantryman. Continuing that line of thought, we chose to make the warriors hard-shelled ground crawlers, with tough bodies that could resist small-arms fire. We also gave them praying mantis-type attack claws, beaks, and sharp, pointed toes.

“After nailing down the warrior, we spliced together the biologies of real stink bugs and fireflies to come up with plasma bugs — gigantic creatures that could eject plasma from their lower abdomens into a planet’s upper atmosphere, resulting in spaceships being knocked out of orbit or asteroids off course. The plasma bugs became the heavy artillery of the aliens.” Another class were the tanker bugs. “Tankers were supposed to be the bugs’ light artillery or, well, tanks. They could regurgitate a corrosive acid ignited by organic sparkers near their mouths, spewing out a cross between an acid bath and a flame-thrower. The hopper bugs, another classification, were genetically modified warriors, capable of gliding on air currents and shearing off human heads.”

Since every army — even a bug army — must have a general, Hayes and Verhoeven invented the brain bug, a grossly fat, yet hyper-intelligent being that controls the activities of the entire bug army. “Because it is so fat,” Hayes elaborated, “it is relatively helpless, physically, and rides around on the backs of little courier insects, which also act as information gatherers. We called those chariot bugs.” Using those concepts as a starting point, Hayes designed a huge, pulpy brain bug body with withered legs. “I thought it would be interesting to have pulsing ripples periodically moving just under the flesh on the top of the brain bug’s head — an effect we dubbed ‘the meat wave.’ For his face, we hit on using multiple eyes, like a tarantula’s, and a slitted, sexually suggestive mouth organ. From that unfolds a hollow, pointed proboscis — another sexual suggestion — which can spike the top of a human head and suck its brains out.”

The majority of the bug designs were completed by the end of 1993. *Starship Troopers* now had a script, a director, a producer, Tippetts Studio and an array of insect designs — and yet studio executives still balked at giving the picture a greenlight. In part, their hesitance stemmed from an uncertainty as to how such imaginative designs could be realized on screen. To allay concerns, Davison convinced the studio to fund a \$225,000 test. That ‘bug test’ ran just under two minutes in length and was directed by Verhoeven on a single day of filming at Vasquez Rocks, a striking, much-filmed geological formation situated just outside Los Angeles.

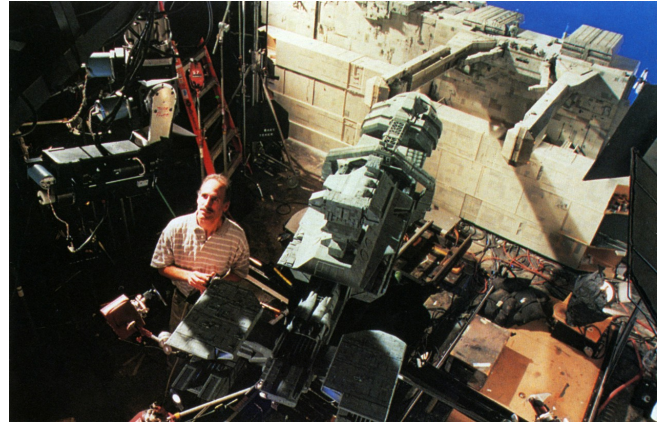
Not only was the bug test a selling tool for the movie, it was a chance for Tippett Studio to explore bug-rendering methodologies, specifically for the warrior bugs, whose design elements were finalized by the time the test went before cameras. Creating the digital warriors for the bug test was a quick, low-budget affair; but, as a result of the test, procedural and design kinks in the creatures were worked out, such as the decision to give the warriors only four legs instead of the six or eight found on real insects and arachnids. “Going with four legs was purely practical,” admitted Hayes. “Four legs meant that our animators needed to spend only half the time moving them around. We also had a chance to tweak the colorization of these bugs during the test. Paula Lucchesi, who led the paint jobs on all of the bugs, originally came up with a dark red pattern for the warriors. Later, we decided to change it to yellow, the coloration you see on wasps and yellowjackets. It is a natural warning sign, signaling other creatures to stay away.”



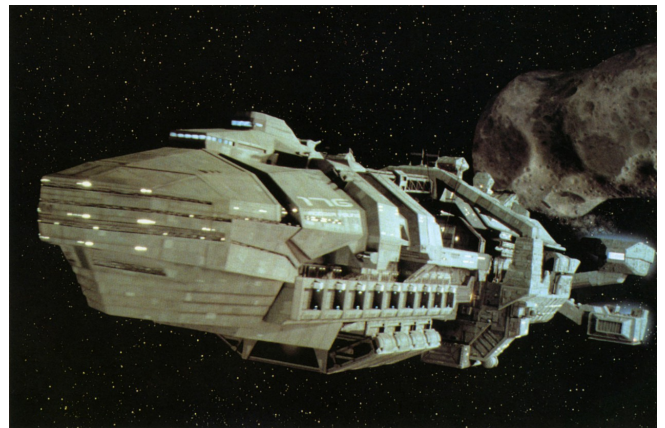
Starship Troopers' 'World War II in space' motif called for a variety of spaceship models. For live-action interiors, full-size prop ships — such as the fleet trainer that pilot trainee Carmen Ibanez (Denise Richards) hot-dogs through the Lunar Ring space station — were also built. To create banking moves, the props were mounted to a gimbal, devised by physical effects supervisor John Richardson, and photographed against a greenscreen.

When the bug test was screened for studio executives in September 1994, the film was finally given an official greenlight. But another year would pass before the start of preproduction, as the studio looked for another distributor with which to split the movie's high production costs. During that time, Neumeier proceeded through a series of script rewrites, reluctantly dropping some of Heinlein's most beloved concepts. One of the elements in the novel that would be omitted from the script was a race of tall, thin aliens, named the Skinnies. "Paul Verhoeven thought that the introduction of a second extraterrestrial culture was too confusing," revealed Neumeier. Also dropped was Heinlein's 'power armor,' sophisticated exoskeletons that enhanced the military man's strength and firepower. "Those constructs are probably the most well-remembered things from Heinlein's novel, besides the bugs. We would have loved to include the power armor, but it proved so horrendously expensive that the question eventually came down to this: What did we want to see in this movie, power armor or bugs?"

Despite the elimination of such ambitious, costly elements from the script, the project had grown to epic proportions by the time production was launched. Approximately six hundred effects shots would appear in the finished film, two hundred of which were bug shots, earmarked for Tippett Studio. In contrast, *Jurassic Park* — generally considered the benchmark for photorealistic computer generated characters — had featured only fifty. "Just the volume of shots in *Troopers* was going to far outstrip anything we had done on *Jurassic*," Tippett stated. "*Troopers* was going to highlight a number of huge battle sequences, requiring hundreds, if not thousands of bugs, all of which would have to be staged and choreographed." But what really differentiated *Starship Troopers* from *Jurassic Park* was that the CG creations in that much lauded film had been based on real physiological creatures. "We'd had concrete reference points for those dinosaurs. And when the weight and the joints of a real animal — even an extinct one — are available to you, you pretty much know what to do with it digitally. But when you've got something that's never really existed, such as the insects of *Starship Troopers*, suddenly the tail is wagging the dog. We had these great bug designs that Craig had come up with; but trying to figure out what these creatures could do — what, for them, would be a realistic gait, or a lifelike action — became an enormously complex enterprise." The complexity of the project — made more so by Verhoeven's decision to shoot *Starship Troopers* in broad daylight —



Carmen's training continues aboard the Rodger Young battle cruiser. Industrial Light & Magic provided shots for the scene in which she first maneuvers the huge vessel out of its lunar dock. ILM effects cinematographer Pat Sweeney prepares the motion control setup, which consisted of a nine-foot-long ship model and a miniature dock section provided by Sony Pictures Imageworks.



Tensions mount when a bug-launched asteroid strikes the Rodger Young, severing its communications tower.

plus the enormous number of bug shots, prompted Tippett Studio to carry out a digital recruiting drive that resulted in one hundred CG artists, composers, animators and other technicians being hired.

Although bugs would be the main engine driving the movie, *Starship Troopers* would also feature numerous space battles and spacecraft, executed by Sony Pictures Imageworks under the leadership of visual effects supervisors Scott E. Anderson and Dan Radford. Ultimately, SPI would produce approximately 120 space battle shots for the movie. “Paul Verhoeven’s intent was to create an epic war picture,” stated Radford, “with spectacular battles on the surface of different planets and in outer space. Our primary shot load would show squadrons of earth ships massing above bug planets, and the subsequent battles that would take place above those planets. The scope of these shots was so vast, SPI had about 270 people working solely on *Starship Troopers*.”

SPI would employ CG tools to create starfields and planets, while the fleet service ships would be done through a combination of models, motion control and additional digital elements. Verhoeven made it clear that he did not want *Star Wars*-type spaceships darting about at light speed. “The analogy he gave us,” said Radford, “was that he wanted the ships to maneuver and look like *World War II* naval battleships, or like contemporary oil tankers — huge, ponderous, slow-moving things, with a great deal of weight and mass.”

“I tried to come up with spaceships that would look like real ships of the future,” Verhoeven elaborated. “The Rodger Young, for example — which is the principal battle cruiser in the film — is not extravagantly streamlined. Since there is no air or water resistance in space, such streamlining would be nonsense. We tried to design ships that looked as if they were built strictly for use in space, craft that had never been designed to enter any atmosphere. Like spacecraft of the future will probably be, ours were built along purely utilitarian lines.”

Design chores for *Troopers*’ spacecraft were turned over to SPI art director Michael Scheffe, who produced highly detailed drawings and paintings over the following months, based on designs generated by production designer Allan Cameron and his art department. The various types of ships included drop ships (air-to-ground troop transports), retrieval boats (used to pick up soldiers from designated landing points), attack craft (nicknamed ‘Tac fighters’), reconnaissance ships, space-going tenders and small tugs. The primary spacecraft, however, would be the enormous battle cruisers, done up in various configurations and sizes, but each harking back to the look of the main Rodger Young battleship, designed primarily by conceptual artist Jim Martin. Production of all the spacecraft was assigned to SPI’s Thunderstone model shop, which built more than one hundred models out of foam, wood, metal and plastics.

The battle sequences were so numerous and complex that SPI engaged Pixel Liberation Front to previsualize them as digital animatics. “There were so many layers and so much movement involved in our work for *Starship Troopers*,” commented Radford, “without previsualization, we would have had an enormous problem correctly shooting each effects element. Pre-viz allowed us to not only block out a shot, but marry together the various elements into very precise performances.”

Starship Troopers’ principal photography began on April 29, 1996, in a unique geological formation called Hell’s Half Acre. Located about forty miles outside Casper, Wyoming, the area’s dusty peaks and valleys would stand in for the bug planets of Klendathu and Planet P. More location shooting would occur in the badlands of *South Dakota*, where the privately owned Barber Ranch would stand in for Tango Urilla, another alien world. The bulk of the production period, however, was spent on the stages of Sony Studios, or at locations around Los Angeles.

Live-action plates for the CG bug shots were orchestrated by Tippet crew members. “We’d first do 3-D aerial mapping of the topography,” explained Tippet, “then tie that in with surveying information we pulled in through an electronic instrument called a theodolite. From there, we grabbed an encoded, four-perf shot of the actors interacting with the nonexistent bugs. Paul Verhoeven would determine which takes with the actors looked best. We’d then play back the exact photographic parameters used for those shots through the motion control system, in order to duplicate the camera movements for a second, clean pass. We also shot a large gray sphere we’d positioned in the same frame, allowing us to gauge how the light was falling. That footage became our prime photographic reference.”

A major presence during principal photography was Amalgamated Dynamics Incorporated, whose on-set effects included a variety of full-scale bugs. “Although the main effects emphasis was going to be on Phil Tippet’s CG bugs,” commented A.I. co-founder Alec Gillis, “the production also knew it would have to employ a number of real bugs — full-scale props that could be used as set dressing, or as objects for the cast to interact with, or as actors themselves. To meet those demands, we had to expand the size of our work force, until we had around seventy people dedicated to the picture.” Other primary contributors to the film were physical effects master John Richardson, employed to provide on-set pyrotechnics and other effects, Kevin Yagher Productions, which supplied background dummies and prosthetic makeups, Visual Concept Engineering, which provided digital



Shots of the rogue asteroid impacting with the Rodger Young were realized by Boss Film Studios. An eighteen-foot-long Rodger Young model was mounted via wires to an overhead truss system that enabled flight maneuvers to be simulated in the manner of a marionette. An eight-foot-long asteroid model — likewise suspended from the computer controlled truss mechanism — was photographed separately.

effects and cleanup, Industrial Light & Magic, which contributed shots to a variety of scenes, and *Compound Eye*, responsible for the film's digital matte paintings and other images for multi-element composites. In addition, Banned From the Ranch Entertainment rendered the show's video graphics, with on-set video playback orchestrated by Video Image.

The movie opens with a recruitment and news bulletin from the Federal Network — the first of many featured in the film. “The Federal Network, or FedNet, is the primary source of public information for earth,” noted Verhoeven. “It's sort of a futuristic, evolved Internet. It's also a prediction of the marriage between TV and computers that I think will eventually happen.”

Banned From the Ranch supplied four dozen graphics overlays, transitions and design elements to the FedNet sequences. “Most of our work entailed coming up with appropriate font styles and ways to incorporate fonts into the FedNet live-action elements,” recalled BFTR co-founder Van Ling. “We generated 2K files for text such as ‘WAR!’, ‘INVASION’ and ‘THEY’LL KEEP FIGHTING — AND THEY’LL WIN!’ Since the FedNet segments were tonally different from each other — some folksy, some sad, some angry — we applied different text styles, keeping to the overall hard metallic look that Verhoeven liked. Not all of the text inserts were static overlays, however. For example, to make the font for ‘WAR’ more dynamic, we took the golden FedNet animation logo and let the gold reflect flames behind it, before doing a pullback to a matte painting.” Besides text overlays, BFTR supplied FedNet graphics such as the stylized eagle and spinning globe logo, a galaxy map and starfields.

Included in the opening FedNet broadcast is a shot depicting thousands of fresh-faced troopers in strict formation. Live-action elements were shot on the Camp Currie set in Fountain Valley — setting for the film's boot camp scenes — with a cast of only three hundred extras. *Compound Eye* — founded by veteran matte artist Mark Sullivan — worked with elements filmed by second unit director Vic Armstrong to digitally replicate the three hundred extras into thousands. “We split our three hundred troopers into four rows of seventy-five people each,” explained Armstrong, “lining them up next to each other on the Camp Currie parade ground and filming them. Then we continued to shoot that same four-row pattern through eight subsequent shots, carefully moving our rows sideways until, by the ninth shot, they'd traversed the entire parade ground. Staging the shot this way allowed us to do it all on one negative, with the separate rows digitally comped back in as a single element. To rotoscope out possible problem areas, 150-foot-long green-screens were laid on the sides of the rows. *Compound Eye* had the option of using the greenscreen to ensure that the heads of extras in one shot properly crossed the bodies of troops standing next to them in another.” To minimize problematic shadows, the scene was shot at high noon. Each of the nine setups was filmed as an encoded pullback, slaved to a Kuper computer system so that camera moves could be repeated exactly.

After a news brief showing troops and bugs engaged in battle on the planet Klendathu, the FedNet sequence dissolves to a legend reading, ‘One Year Earlier.’ In futuristic Buenos Aires, students Rico (*Casper Van Dien*), Carmen (*Denise Richards*) and Dizzy (*Dina Meyer*), listen to a lecture delivered by Mr. Raszak (*Michael Ironside*) on the distinction between a citizen — one who has served the Federation — and a mere civilian. The futuristic view of Buenos Aires was provided by *Compound Eye*. “As the film folds back chronologically,” noted Sullivan, “there's a wide tilt-down/dolly shot of students walking across the campus, with a futuristic view of the Buenos Aires skyline in the mid to far distance. A digital matte painting of that skyline was motion tracked to the live-action plate,

which had been filmed at the Kaiser Permanente medical facility in Baldwin Hills.” To sweeten the shot, Sullivan also added CG fighter jets that were animated and comped into the painting element.

A war veteran, Raszak has lost his left forearm and hand — an illusion created by Kevin Yagher Productions. “For scenes showing Raszak’s stump,” said Yagher, “we came up with two devices. One was a fully functional cable-controlled arm, operated by Evan Brainard, who also mechanized it. It had silicone skin, a fiberglass undershell and standard bicycle cables inside that acted as the primary controlling devices. We also made a rod puppet arm, which had a small rod protruding from the rear elbow that Michael could manipulate with his other hand, behind his back.” Both devices were cast from a mold made from Ironside’s arm. “We made a clay positive from that mold, which we whittled down to a stump. That nub, in turn, was cast up to arrive at another mold, into which we poured silicone. Those silicone stumps were tinted to a flesh color, punched through with human hairs, and painted by Thom Floutz. They were then strapped onto the actor by a shoulder harness.”

The students next move on to a biology class, where they dissect Arkellian sand beetles — tortoise-sized bugs, designed and built by A.I. Since the sand beetles would be represented by practical props, rather than computer generated models, they were the only bugs in the film not designed by the Tippett team. After a sculpture of the sand beetle was approved by Verhoeven, A.I. cast twelve positive pieces from silicone molds for each full-size bug. Among the pieces were a translucent skinflex head, a urethane body, six skinflex legs, plus mandibles and spines. Nine sand beetles were made, each three feet long and two feet wide. A hero version was painted with acrylics and detailed with individual horse hairs, then packed with a combination of ultraslime, methocel and nylon to represent internal fluids and organic structures. Additional sculpted silicone organs were also packed into the hero beetle’s abdomen. A final thin silicone membrane was then placed under the urethane belly shell to hold the bug’s ‘guts’ in place until the abdomen was split open by a power tool in the dissection scene. An air bladder installed within the abdomen — inflated manually via a compressed air rig — created the illusion of pressurized internal organs.

The young lovers, Carmen and Rico, part when the former is accepted into the Fleet Academy, where she will train as a starship pilot. A shot of Carmen at the Federal Transport Authority, stepping into a transporter device that travels through the future earth’s network of underground tubes, was contributed by Peter Kuran of Visual Concept Engineering. “First unit filmed a live-action plate of Denise Richards stepping into the full-scale transporter prop,” related Kuran. “Jim Lammers painted a digital environment around that prop — tracks, walls, cables, everything. He also pulled a perspective change on the live-action footage, so it looked like the capsule was moving backwards. Then we composited all that with the location footage.”

Inspired by Carmen’s ambition — and hoping to impress her — Rico enlists in the mobile infantry, reporting for duty at Camp Currie. An establishing shot of the camp, filmed on the Fountain Valley set, was digitally extended by Compound Eye, which added embellishments such as painted tents, towers and tarmac. Additional troopers were composited into painted areas, along with rotoscoped flags.



Sony Pictures Imageworks was charged with the vast majority of the spaceship shots, including those of the fleet

At Camp Currie, Rico and fellow recruits Dizzy and Ace Levy (Jake Busey) are subjected to brutal training under Sergeant Zim (Clancy Brown) who, at one point, throws a knife into Ace's hand, pinning him to a wall. Yagher Productions created a prosthetic arm and hand for Busey. "We pulled a mold off his real right arm and hand first," explained mechanical designer David Miner, "then built up a foam core duplicate with silicone skin and an inner, mechanical structure — made from nylon and aluminum — which moved the fingers, wrist and thumb. Busey's real arm was strapped behind his back, and our artificial one was attached to him by a shoulder harness."

Another Yagher creation, a half-torso puppet, was also featured in the boot camp sequence, for a scene in which a cadet named Breckinridge (Eric Bruskotter) has his head blown off in a live-fire exercise. "The Breckinridge dummy had a fiberglass head and polyfoam torso," said Yagher Productions supervisor Shaun Smith. "We used dental alginate to pull a life-cast off of the actor's head, built a fiberglass skull from that, added glass eyes and human hair, and wrapped it all up with a silicone skin painted by Thom Floutz. Movements of the eyes and jaw were radio-controlled through mechanisms built by Evan Brainard." A closeup of the top of Breckinridge's head coming off was accomplished by yanking on a thin monofilament line attached to a prescored section of the dummy's skull. "We also used compressed air to blow stage blood and our own manufactured brains — made of methocel, silicone parts and stage blood — out of Breckinridge's wound." Animator Harry Moreau, at VCE, added dozens of red, blue and green laser flashes to the live-fire sequence, generated as traditional backlit cel animation, then scanned as digital files.

The action shifts to the moon-based Fleet Academy, where Carmen skillfully maneuvers a fleet trainer through the Lunar Ring space station encircling the orb. The sequence featured a handful of the forty-four-shot total realized by ILM. "We called it 'Carmen's Wild Ride,'" recalled ILM visual effects supervisor George Murphy, "and most of those shots featured a detailed, sixty-foot-long, two-foot-tall breakaway tunnel we used to represent the Lunar Ring's interior. We ran our motion control rig through the middle of it, peeling back panels every six inches, so audiences would feel as if they were right in the center of the action. But the fleet trainer itself was computer generated. By doing it CG, Paul Verhoeven had the freedom to choreograph the flight of the trainer any way he wanted."

While exterior views of the craft utilized computer models, interiors were accomplished with a full-size fleet trainer cockpit, mounted to a nine-foot gimbal — built by John Richardson and his crew — to execute banking moves. Constructed of solid steel, and topped by a platform measuring eighteen by twelve feet, the gimbal had two axes of movement and could tilt a maximum of twenty-seven degrees. The entire rig was hydraulically powered and controlled by two manual-move joysticks.

The same gimbal was used to capture the moment, later in the movie, when Carmen, on the Rodger Young bridge, notices that the fluid in her coffee cup is slowly tilting upward while the cup itself remains stationary — a signal that the ship is entering a field of gravity from an approaching asteroid. The live-action illusion was filmed with the camera, a full cup of coffee, and Carmen's instrument panel each securely fastened to the gimbal, which was then tipped to one side. Since

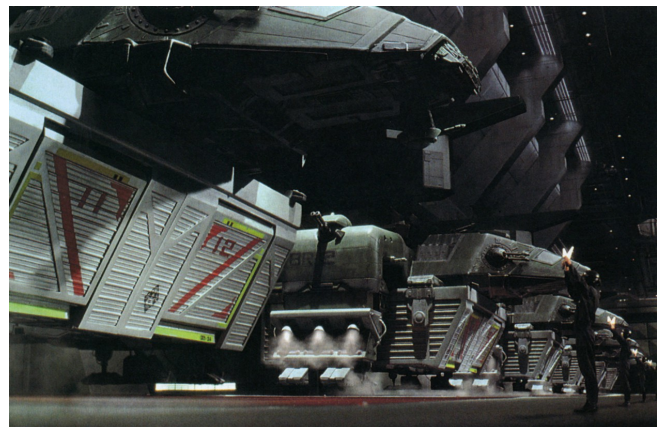
preparing for battle over the big planets of Klendathu, Arishla, and the moon-based Fleet Academy. The facility's Thunderstone model shop produced more than one hundred miniatures. Background ships were often photographed in multiples to reduce the number of time-consuming motion control passes. Planets and starfields were rendered digitally. Matte painting of the ravaged city.

the camera was locked down in respect to the other secured objects on the platform, only the coffee within the cup appeared to move.

While the small gimbal was useful in many instances, scenes on the full Rodger Young bridge — such as those in which Carmen teams with Zander (Patrick Muldoon) for flight training — required a much larger device. “The set that was built for the Rodger Young bridge was so big,” said Richardson, “and some of the scenes called for such aggressive tilting and shaking, that a decision was made to build a large, single-axis gimbal on which that entire set could rest.” Made primarily of steel, the gimbal measured forty by fifty feet, weighed 20,000 pounds and could support another 60,000 pounds of sets, actors, technicians and equipment. Hinged at one end, the rig was essentially a six-foot-tall metal platform. A significant section of the platform could be elevated to a twenty-degree angle through a complex arrangement of pulleys, vertical rams and wire cables connected to twin steel towers bolted into the concrete floor on either side. The lifting movements were manipulated by an electronic joystick linked to a computer control system.

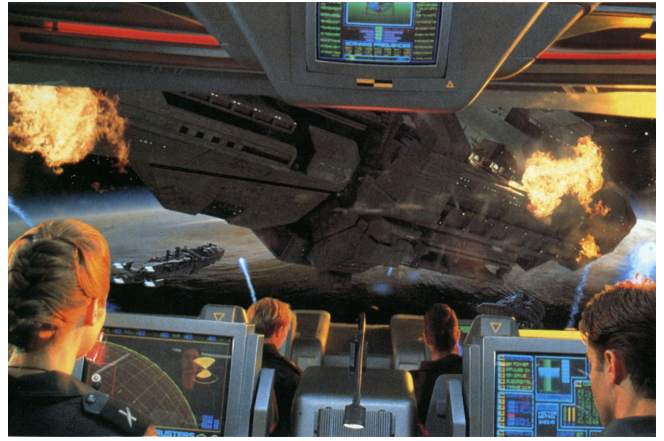
Scenes on the Rodger Young bridge showcased some of the most visually arresting of the computer and video graphics supplied by Banned From the Ranch. “There were about nine functioning computer monitors on that set,” observed BFTR on-set supervisor John Lima, “and we did an average of three to four graphics per monitor. Plus, there were different images constantly coming up during every scene that showed Carmen and Zander in front of their monitors — graphics showing them trying to track an asteroid’s trajectory, or warping the ship into space, and so on.”

On-set playback of these graphics was overseen by Video Image. “We ran wiring from the on-set monitors to a central command post we called Video Village,” said Video Image on-set supervisor Robert Chartier. “Video Village had its own playback equipment and monitors to keep tabs on what was being shown on the set, and an independent power supply. We also installed multiple videotape decks in there, plus a number of PCs equipped with 24-frame playback cards, to allow us to digitally pump the graphics onto the sets. That way, we could alter the data involved in each graphic — its size, color, speed — in a quick, efficient manner, and make it interactive.”



With the declaration of war, ground troops are transported via drop ships from hovering spacecraft to the targeted planets below. An interior view of the landing craft within the hangar bay of the Rodger Young was created by SPI. Motion control step-and-repeat elements, gleaned from a single drop ship and bay miniature, resulted in a final composite revealing many ships preparing to launch.

Exterior shots of Carmen maneuvering the Rodger Young out of its lunar dock during her training were achieved with a nine-foot-long ship model built by the ILM model shop, under the supervision of Charlie Bailey. The docking unit itself was a joint ILM/SPI project. "SPI sent us a docking unit model that was about six feet across," stated Murphy. "Then we detailed it out, adding panels that connected the dock to the lunar ring." ILM also computer generated the two massive, snake-like docking umbilicals that connect the Rodger Young to the lunar dock as Carmen backs the ship away from its berth.



From the bridge of the Rodger Young, Carmen and flight teammate Zander Barcalow (Patrick Muldoon) witness the collision of two fleet battle cruisers, the Marshall and the Yamamoto. Wide views of the imminent collision were realized through motion control model photography, while computer models provided closeups of the actual points of impact. Graphics displayed on the Rodger Young bridge monitors were designed and executed by Banned From the Ranch.

What follows is another FedNet bulletin, alerting the principal characters to the fact that alien arachnids have launched an asteroid at earth, which has destroyed their home town of Buenos Aires. Mark Sullivan provided a digital matte painting for an establishing view of the city in ruins. "The live-action element for the destroyed Buenos Aires shot was filmed in downtown Los Angeles, using a Vistavision camera," Sullivan stated. "Production had built a rubble pile about twelve feet high in a vacant lot, equipped with hidden propane burners and filmed with a lot of extras dressed as either survivors or government rescue workers." The Los Angeles skyline in the background was garbage-matted out, then replaced with a painted scene of total urban destruction. "There were also sixty-eight individual fire elements, shot live, then reduced and digitally comped into the remains of some of the painted buildings. CG smoke plumes and several rotoscoped extras breaching the matte line of painted portions of the frame completed the shot."

Compound Eye also enhanced subsequent shots of Sky Marshall Dienes (Bruce Gray) declaring war on the bugs within the Federation council chamber, creating two focal-length views of the chamber — one via digital matte painting and the other via a CG model. A small set showing various council members on the chamber's central stage was filmed from a twenty-foot-tall scaffold, with Sullivan, aided by director of photography Jost Vacano, carefully recording measurements detailing the set's angle, distance and elevation from the camera. Those statistics were precisely matched when the same camera was placed on a second-floor balcony inside Beckman Auditorium at the Cal Tech campus in Pasadena, which served as the full chamber. To create a vast crowd within the chamber, a small number of extras was filmed as a group and cloned into different areas of the auditorium by Richard Cohen. "When the film we had shot of Marshall Dienes was reduced down," commented Sullivan, "it fit very well inside the elements we'd shot at Beckman Auditorium. The last component involved doing a matte painting to replace the brightly colored walls at Beckman Auditorium with a big Federation seal and heavy, marble-based architecture, modeled in 3-D by Richard Cohen."

With the declaration of war, both ground troops and the Federation's fleet of battleships prepare to launch an attack on the bug planet of Klendathu. Shots showing the amassing ships in space were

filmed by SPI, which conducted its model photography on a rented commercial stage in Culver City. “That facility was subdivided into three shooting stages,” stated SPI director of photography Alex Funke, “on which all our motion control and miniature photography could be done. Many of these shots were accomplished by custom built computer-controlled cameras mounted on the ends of electronically slaved boom arms, wheeled down tracks measuring twenty to sixty-five feet in length. We also used a couple of huge model movers, in conjunction with motion control rigs.”

The Klendathu sequence begins with a wide shot showing hundreds of troopers running into the holds of small drop ships — nimble landing craft first seen parked in the belly of the massive fleet starship Bull Run. Live-action elements were filmed at a Delta Airlines hanger at Los Angeles International Airport, where approximately two hundred extras were photographed in front of a greenscreen, hustling into the holds of two full-scale drop ship compartments. Four different film elements shot at corresponding distances in front of the screen were then composited together by *Compound Eye* to create the illusion of a thousand troopers running across the frame. *Compound Eye* combined the trooper replication with a detailed matte painting depicting the ceiling and walls of the Bull Run and additional drop ships. Animated lights, plus a subtle roll-and-pan camera move were then introduced in the composite. “In the next shot,” said Dan Radford, “you see the drop ships pushing back into their individual launching bays. That was done by building a single six-foot bay miniature, hanging a model drop ship in it, and then shooting motion control step-and-repeat elements in order to multiply the number of bays and ships in the final shot.”

The action next cuts to a long traveling shot outside the Bull Run, showing the drop ships emerging into open space and locking onto the side of the vessel’s hull. “In order to sell the scale and scope of that shot,” explained Scott Anderson, “we first took seven step-and-repeat shots of the six-foot Bull Run docking bay and miniature drop ship. Those elements were digitally wrapped around the much smaller scale, eighteen-foot-long Rodger Young-class model that was standing in for the Bull Run. That model was shot upside down at a later time, with a different motion control setup. The fleet was filled in using maquettes of various other ships — models that had again been shot at different times in yet a smaller scale on a different motion control stage. The final challenge lay in compositing all of this together with the digital elements.”

Launched from the Bull Run, the drop ships descend toward Klendathu in one of the most element-heavy shots in the film. “After the drop ships leave the Bull Run,” Anderson continued, “there’s a 180-degree view of the planet, its oceans, the rest of the fleet, and bug plasma coming up from below. Every type of digital effect and every scale model that we built for *Starship Troopers* was at work in that one shot: the eighteen-foot-long Bull Run model, which was used for the closeup of the drop ships disengaging, our large-scale drop ship miniatures, which were about four and a half feet long, one nine-foot-long Rodger Young-class and some smaller ships in the background, plus digital cargo ships shuttling between them. Each model ship was then tied to its digital elements, such as thrusters. Everything in the Klendathu reveal was also accented with interactive lighting passes. Finally, all the ships flew in a totally digital environment — the stars were digital, as were the planet Klendathu, its twin suns, and the rising bug plasma.”

The digital planets originated with traditional matte paintings, rendered by Eric Chauvin, which were then introduced to the CG systems. “The planets were an interesting hybrid,” said Radford. “Eric started by painting them traditionally on glass panels. Those paintings were then digitized,

and the resulting files imported to our digital 3-D and 2-D departments. The CG work began when the art was textured through digital retouching. The results were then wrapped around computer generated 3-D globes. Reflections were added to Klendathu's oceans, as was the surrounding atmosphere, suggested by applying digital clouds and weather patterns to the planet art."

In addition to its space shots, SPI contributed to one ground scene that would become the signature shot of the movie. "You see three drop ships that have landed on Klendathu, bunched together in a 'V' shape," detailed Anderson. "Troops are running out, the ships are firing at unseen bugs and, in the background, bug plasma is shooting up into the sky." The multi-element shot — featuring two miniature ships, plus digital 'tops' added to full-size ships used on location — was composited on the Inferno, judged to be the most efficient tool for that particular task. "Production wanted to use that Klendathu ground shot for its first *Starship Troopers* trailer, but they were on a tight deadline. So Dan and I turned over those compositing chores to our senior Inferno artist, Shannon Noble."

Another spectacular effect in the Klendathu sequence was the collision of the Marshall and the Yamamoto, two Rodger Young-class ships that collide after being hit with a barrage of plasma. "Paul Verhoeven intended that the collision be emotionally visceral," Anderson commented. "He didn't want to see *Star Wars*-type shots, where spaceships crash into each other and are immediately vaporized by a fireball. He wanted shots that supported our 'supertankers in space' concept, with huge, ponderous things slowly slamming into each other as metal curled and warped at the point of impact. Then small, secondary explosions would erupt throughout both ships."

The initial collision was accomplished by shooting the two spacecraft models as separate elements, while the actual moment of impact employed CG representations of just the colliding portions of the ships. "Essentially," explained Anderson, "we built up a number of motion control passes on the models — passes showing the ships undamaged, passes showing them damaged, interactive lighting passes — before digitally replicating the lighting employed in those motion control shots. Then we laid the replicated lighting setups and passes over the computer generated collision. We knew we couldn't do the collision with any form of model photography — not to our satisfaction, anyway." To save time and resources, Anderson opted to shoot many of the background spacecraft in setups featuring up to eight different ship models in a single pass. "The scope of this movie dictated that we shoot several models at a time in order to keep the total number of motion control passes down. One thing that helped were the extremely bright fiber optic sources we added to our models. Their intensity allowed us to combine fiber optic passes with beauty passes."

Small fires dotting the surfaces of the spaceships were created with practical pyrotechnics. "No CG pyro was used in the film at all," asserted Radford. "One reason was that Paul had asked us to use the ship fires as rim lights, to help illuminate what was happening on the surface during the destruction of that ship. Scott and I felt that such interactivity would be difficult to do digitally, and we both preferred to rely on photographic elements. Neither of us had ever seen a CG fire that we found totally convincing, especially on the scale that we wanted to portray the fires in *Starship Troopers*." All of the pyrotechnic work was done at a much larger scale than the models. "By working very closely with Alex Funke, we were able to previsualize foreground and background perspectives and scales for every pyro shot before we filmed it. This freed us from just shooting abstract fires and explosions, then randomly stapling them onto the ships." Different chemistries were explored to produce fires that were smokeless and colorful, since Radford and Anderson wanted to avoid the

orange-red colors seen in most fires in favor of unusual elements that suggested the ignition of exotic, futuristic materials. Most of the pyro effects were shot against bucks — simple metal forms that duplicated the shape of the miniature environment into which the explosions would be composited. SPI utilized two pyro units. Ian O'Connor handled the basic burn elements for the battle cruisers, as well as some smaller ships, while John Kazin and Thaine Morris took the larger-scale work, including stand-alone fireballs and the destruction hits on the Rodger Young.

Additional ships-in-space shots were assigned to ILM when SPI's workload grew to unmanageable proportions. "We built a large forty-foot pie section of the Ticonderoga battle station," said George Murphy, "for the scene where you see some of the Rodger Young-class ships limp back to space dock after being damaged over Klendathu. We also built those ships, which were about three feet long." While SPI built the primary eight-foot-tall Ticonderoga model, the miniature was sent to ILM for detailing and filming.

An additional twenty-four Rodger Young shots were farmed out to Boss Film Studios. In fact, *Starship Troopers* was the last feature assignment to be accepted by the esteemed facility before it closed its doors. "What we were working toward," said Boss visual effects supervisor David Jones, "was the successful completion of two sequences involving the Rodger Young. The first featured a shot with an amazing camera move that begins out in space above the ship, dives down towards the miniature, abruptly tracks off at a ninety-degree angle, swings around, then moves in towards the bridge, with Carmen in the window — all in one shot."

Boss achieved the dynamic camera move through the careful orchestration of disparate elements. Using molds from SPI, the company fashioned its own eighteen-foot miniature of the Rodger Young. "We then photographed the model motion control," said Jones, "using a 24mm snorkel lens attached to the end of a boom arm for the dive down towards the Rodger Young and subsequent swing around to the front of the ship. That shot was then married up to a digital camera move, after the entire front end of our miniature was digitally replaced to make the ship's bow section look more detailed. Finally, the digital section was match-moved to live-action footage of Carmen on the bridge set — footage captured with the camera on a swinging boom so that all the elements would match up."

Boss complemented its motion control work with an overhead truss system. "Essentially it was a gravity-controlled model mover," observed Jones, "a way of hanging a miniature from the ceiling much like a giant marionette, then motion controlling the wires to act in conjunction with our regular computer-controlled camera rigs. Two trusses were installed on stage for our effects scenes. They allowed us to make the Rodger Young model bank or turn, or rise up to twelve feet off the floor. The entire time, this enormous model was literally hanging from the ceiling."

The truss was utilized for a second Boss sequence, in which the Rodger Young collides with a rogue asteroid the bugs have deflected towards earth. Computer controlled shots of the Boss Rodger Young model were composited with separately filmed footage featuring a highly detailed, eight-foot-long, Boss-built miniature of the asteroid, hung from the truss system and photographed against a tangerine-colored screen. For shots of the ship diving under the meteor, a separate, twenty-foot-long section of the asteroid was built, also photographed with the truss system. Subsequent shots of the asteroid actually clipping off the ship's communications tower were

achieved with a tower model that stood eight feet tall and eight feet wide and had a detachable upper section.

As war rages in the skies, ground troops conduct a surface invasion of Klendathu, engaging swarms of warriors and other bugs in combat. While each shot presented its own set of artistic and technical challenges, all of the computer generated insects contributed by Tippet Studio went through a similar process, beginning with a series of low-resolution, digitally-created animatics. Once Verhoeven had approved the animatics, Craig Hayes' designs were sculpted into three-dimensional maquettes by Pete Konig and Martin Meunier. An in-house 3-D digitizer was then used to make a wire-frame of the models. In the case of the tanker bug, the digitizing step was skipped, and the model was built entirely in Softimage by Blair Clark. Once a computer model was built — either through digitizing or by hand — it was refined in Softimage, and set up with kinematic chains for animation. The computer models were then painted by Paula Lucchesi and Belinda Van Valkenburg, who also assigned surface characteristics to the bugs, using shaders written for RenderMan.

The animation itself was divided into two categories, with seventy percent of the workload, including tanker, hopper and brain bug animation, achieved through standard key-framing and mouse-click techniques. The remaining thirty percent utilized four new Digital Input Devices, built by Merrick Cheney in the shape of warrior bugs, since virtually all of the DID animation would focus on their animation. The DIDs were divided into two types — one for real-time work, used for quick background shots of bugs leaping or snapping, and another for more complex and laborious stop-motion-type animation. A hardware interface board and specialized software had to be written to link this second type of DID directly to Softimage.

Another key tool used by the Tippet team was Dynamation, which proved invaluable for the creation of bug swarms. "Normally," explained senior software developer Doug Epps, "Dynamation is utilized to generate things like smoke clouds or jet exhausts. But Dynamation also allows you to do procedural animation of points or particles — a capability that was critical in laying out the swarms. We knew we had to do hundreds, or even thousands, of bugs in some shots, and we certainly didn't want to have to hand-animate all of them. So we used Dynamation's particle systems — tweaked with software written by Eric Leven and Darby Johnston



Phil Tippet and his Tippet Studio team produced more than two hundred computer generated bug shots — a total that established Starship Troopers as one of the most ambitious computer animation assignments ever realized. The first CG bugs to appear in the movie are warriors that engage ground troops in battle on the planet Klendathu.



In the course of the nighttime skirmish, a mobile infantryman dies in the jaws of a warrior bug. Live-action elements of a performer interacting with a full-size

— to generate dozens of little dots that we could then apply en masse to a plate. Dynamation gave each bug dot its own radius and terrain maps and maximum velocity vectors, which allowed it to maneuver over the landscape of a given scene without hitting other bugs or obstacles such as rocks. That process really saved us. We'd still be doing swarms if it hadn't been for that software."

warrior puppet — built by A.I — were intercut with Tippett shots featuring a CG trooper and bug.

Two plasma bugs are encountered early in the Klendathu invasion. Rico and his fellow troopers watch in awe as the towering insects tilt their translucent posteriors skyward, emitting a glowing blue mass of destructive plasma into the atmosphere. The Tippett art department provided layers of computer generated transparencies for the bugs' translucent abdominal sacks, while the illuminated blobs of plasma were rendered through a combination of RenderMan and Dynamation. The shots were further refined in the compositing stage, where CG gradients added a bluish atmospheric haze between the two bugs, plus rising dust elements.

One of the biggest challenges of the plasma bug shots was the amount of rotoscoping required. "The location camera angles were such that the first shot incorporated a moving mass of soldiers," observed compositing supervisor Brennan Doyle, "a pan, and then the introduction of the plasma bugs towering over the troopers at the tail end of the same shot. Obviously, there was a lot of frame-crossing between the live-action and CG elements. There were also troopers crouched behind a little mound, constantly popping their heads up to look at the bugs — which meant more matte lines and more rotoscoping. Our CG rotoscoping department, headed up by Joanne Ladolcetta, did a really good job in making the edges of all the various plasma bug elements look real."



On location in Wyoming, Phil Tippett gleans reference information from a brain bug maquette prior to plate photography.



As Verhoeven orchestrates the live-action, crew members position 'bug sticks,' used to guide performers' interactions with the CG characters.



All of the digital bugs featured in the movie were designed by Tippet Studio effects supervisor and art director Craig Hayes. Bug maquettes provided reference for both the live-action crews and the digital artists.

In addition to bugs, a number of digital humans appear in the Klendathu battle, including a FedNet reporter (Gary Travis), whose body is chopped in half by a bug, Shijumi (Anthony Ruivivar), who is tossed to a group of bugs and subsequently torn to pieces, and Kitten Smith (Matt Levin), whose severed upper torso and head are tossed back at Rico. “Each of those shots featured a separate human CG character,” commented Doyle, “brilliantly animated by Pete Konig. We thought we could get away with using them if we dirtied them down enough, and if they only appeared on screen for a second or two.”

In depicting the deaths of both the FedNet reporter and Shijumi, real people interacting with full-size warrior puppets provided the initial moments of the action, followed by the digital trickery. For on-set use, A.I fashioned two full-scale warriors — nicknamed ‘Snappy’ and ‘Mechwar.’ The puppets — each designed to perform a specific set of functions — were engineered by chief mechanical designer George Bernota and driven by a combination of pneumatic, cable and hydraulic mechanisms. Snappy — named for his articulated jaws, strong enough to lift and hold an actor — was an upper-torso puppet, detailed from the shoulder area to the head. “Snappy had mechanized front legs, attack claws, jaws and head,” said Bernota. “He was operated hydraulically for head rotation, attack claw and upper jaw articulation. Internally, he was mostly steel — we needed a lot of internal strength since this bug was going to be moving actors and stuntmen around.” Measuring about nine feet tall, the puppet was finished externally with a painted fiberglass shell and soft skinflex patches acting as joint covers on the elbows, wrists and shoulders.

Mechwar was a full-body warrior, fifteen feet long and ten feet tall. Capable of approximately thirty separate movements, Mechwar’s head was hydraulically powered, while hydraulic, pneumatic and electrical systems drove its thorax. The legs were puppeteered, and the jaws and attack claws were operated via cable and hydraulics. For the



Animator Bart Trickel manipulates a Digital Input Device — a warrior-shaped armature that was used to translate manual movements to a digital representation of the bug. The device had originally been implemented by the studio during Jurassic Park as a means of translating the hands-on skills of traditional stop-motion animators to the digital realm.



Animation supervisor Trey Stokes adjusts the tension on one of the four DIDs built for Starship Troopers.

effect of Shijumi losing his leg to a warrior, the Mechwar puppet was articulated to bite down on the actor's leg, pick him up and swing him around. Stuntman and amputee Casey Pieretti stood in for the character for specific shots of the leg being torn off. "We replaced Casey's lost limb with a foam one that Mechwar chopped off," said Yuri Everson, A.I.'s on-set liaison and effects coordinator. "Kevin Yagher's group attached a stump appliance with blood tubes onto Casey to make his wound look more realistic. Then we hung him upside down in Mechwar's jaws, using a hidden strap running up inside his pants leg."

While Snappy had required only three puppeteers, five operators were assigned to the more complicated Mechwar puppet. One controlled the attack claws, another was on the jaws, another controlled the head, and two more operated the eyes, feeder claws and antennae. The custom-made controllers were small-scale armatures that, part for part, corresponded to the full-scale puppet. Gross body movement was facilitated by a supporting steel crane, built by John Richardson's department and attached to the puppet at the thorax to provide up-and-down, backwards-and-forwards and rotational movement. As many as eight people operated the counterweighted boom arm to execute the gross body moves.

A.I. also produced fifteen nonarticulated full-scale warriors — ten dead warrior bodies and five charred versions — for this and other battle sequences. After receiving study maquettes of the warriors from Tippett Studio, A.I. did its own set of sculptures. "Those were scaled up from the maquettes," explained Alec Gillis, "molded in silicone, seamed, and cast out of fiberglass. We decided to do the full-scale bugs modularly in order to quickly pop them together as needed, and each bug was broken down into thirty-four separate pieces. We also made backup pieces, in case of location damage. With thirty-four pieces for each dead warrior, multiplied by fifteen dead warriors, multiplied by backups, just manufacturing these things turned into a huge job."

Painting the full-scale bug pieces was an involved process in itself, despite the fact that the paint schemes had already been worked out by Tippett Studio. "It's a different ball game when you're interpreting the coloration of painted reference models into full-scale props," remarked A.I. co-founder Tom Woodruff. "Once we applied the warrior's initial paint job to our magnified versions, it suddenly looked toy-like, just because of the immense size of our bugs." Completed paint jobs were fixed with a lacquer seal, then toned down and aged with the application of sandpaper, dust and other materials.

Additional steps were required to produce the charred bugs. "We cut open a few of our fiberglass warriors in selected areas," explained Steve Buscaino, "then applied a liquid urethane, precolored with black tints that foamed up and gave the bugs a crinkled, charred texture. We also peeled back the bugs' exoskeletons and added bits of colored foam inside to give them a more charred appearance. Then we touched everything up with black paint."

A number of smaller three-dimensional bug props also fell under A.I.'s domain. Among them were several warrior attack claws. Made of fiberglass, the four-foot-long appendages were equipped with handles near the shoulder end that enabled puppeteers to maneuver the claws from off-camera. "A.I. supplied most of the practical bug blood and guts used during production, too," Woodruff commented. "The guts were a mixture of chopped latex and foam rubber scraps, while our bug blood was green-tinted methocel."

Human casualties were likewise depicted, through makeup effects and dummies provided to the show by Kevin Yagher Productions, which supplied wounds, amputated arms, artificial metal hands, punctures, intestines, melted flesh and elaborate half-torso puppets. “In terms of sheer quantity,” Yagher noted, “the most important thing we had to produce were dozens of background bodies. There were various full-size male and female corpses — or parts of corpses — that Paul Verhoeven intended to use for the battle scenes.” Thirty-five dummies were built to provide background atmosphere, while five detailed and lifelike versions were manufactured as hero bodies. Liquid polyfoam was poured into human-sized molds, set, then carved into full-scale bodies by Yagher’s crew. Individual human limbs were also cast up from polyfoam. All the props were coated with thin layers of silicone to replicate the texture and translucency of human flesh. Painted-on flesh tones, along with hair pieces, eyes and teeth finalized the bodies.

In the course of the Klendathu battle, Rico is impaled in the upper thigh by a warrior, an effect that combined an A.I. attack claw, a bloody leg prosthetic provided by Yagher Productions and a Tippett CG warrior. His wound is healed through submersion in a stasis tank, engineered by John Richardson. “The tank was approximately ten feet across,” commented Richardson, “and held 1200 gallons of water. When filled, it weighed about six tons. We manufactured it chiefly from iron and plexiglass. We also made a transparent plexiglass support to hold Casper Van Dien underwater during the shots. Cast off the back half of his body, it became nearly invisible when submerged.”

Within the tank, a ‘knitting machine’ weaves new flesh over Rico’s injured thigh. Also built by Richardson, the device was made of aluminum, equipped with special O-rings sealed with silicone to keep the water out, and operated off-screen by radio control. “We also rigged a closed-circuit breathing system to feed air to Van Dien through a white plastic tube,” Richardson related. After an initial pass was shot, Van Dien’s real leg was replaced with a prosthetic, gouged limb — created by Yagher’s team — that was used for a second pass. A third pass was shot to provide a clean plate with nothing in the tank. VCE later digitally composited all of the passes together. Then, on a frame-by-frame basis, VCE digital artist Pam Vick distorted, manipulated and added pieces of digitally created art to the composite, creating the illusion of new skin being grafted onto Rico’s leg, one layer of tissue at a time.

In the aftermath of the bloody Klendathu battle, the Fleet responds by having its Tac fighters carpet-bomb the bug planet Tango Urilla — a sequence that afforded John Richardson the opportunity to stage spectacular full-scale pyrotechnic explosions during the *South Dakota* location shoot. “I’m rarely given the chance to execute a pyrotechnic effect of that magnitude,” Richardson remarked. “The Tac air strike was one of the largest moving napalm-type runs ever done for a movie. We created a traveling sheet of fire nearly half a mile long, moving at 300 miles per hour — which covered that distance in only six seconds.” Twenty-eight separate fifty-gallon drums were placed at regular intervals in the valley floor, each of which was turned on its side, sandbagged into place, stuffed with both a high-explosive igniter charge and plastic-lined bag of gasoline, then left open at one end. When the burning fuel exited the drums horizontally, the effect was like a line of cannons firing directly at the camera. For variety, Richardson’s crew also buried randomly placed, dynamite ground charges, mixed with fuller’s earth and cement dust, and detonated them sequentially.

Initial views of Tango Urilla reveal swarms of bugs milling around, closely packed together. The ‘Wild Kingdom’ shot — as it was dubbed — and other bug swarms on Tango Urilla relied heavily on Dynamation and other tools. “Dynamation was used to generate the moving mass of bugs,” noted Brennan Doyle, “with individual animation cycles attached to each separate dot, so that no two were the same. We also did some random scaling within that crowd of warriors, so that each had a different size.” The next task was to determine how to break up the warriors, after they have been blown apart by the firebombs. “We solved that by placing hand-animated hero bugs in the extreme foreground of the frame, and positioning a group of less highly detailed bugs — which we called ‘Jacks’ — in the mid-frame and background. We named them Jacks because these particular warriors were going to be tossed up into the air by the force of the explosions, just like a child’s set of jacks.” The actual burning of the bugs in the flames was achieved through a software function called Z-depth information. “By using that data, we determined how far things were from the camera, and how to create mattes that would start eating away each of the individual layers, based on depth. You’d see a bug, then you’d start seeing the flames where the bug used to be — as if they were actually being dissolved by the flames. We also detailed the shots with flying bug body parts.”

With the troopers’ landing area cleared of bugs by the bombing, Rico and his mobile infantry squad land on Tango Urilla. Once on the ground, Rico nukes a bug hole, resulting in subterranean shockwaves that cause the soil to rise twenty feet upwards in a series of curtain-like ripples. While the flight of the launched nuke and its disappearance deep into the bugs’ nest were digital effects supplied by Tippett Studio, the waves of rippling earth were a practical effect achieved by Richardson on location. The special effects team buried numerous naphthalene charges and five rows of primacord beneath the surface of the ground. When detonated, the charges made the earth ripple towards the camera in quickly advancing waves.

As the action on Tango Urilla continues, Rico and friends are threatened by a tanker bug that erupts from the ground and uses its acid to melt off the arm of Lt. Birdy (Ungela Brockman) — an effect



While the majority of the bugs in the film would be computer generated, specific interactive shots required practical bug puppets, designed and constructed by A.I. Two full-size mechanical warriors were built for shots in which the bugs needed to physically lift stuntmen or actors. A.I co-founder Alec Gillis checks out the gripping power of the full-scale Snappy’ warrior.



A.I also contributed a number of nonarticulated bugs for scenes of mass destruction, such as the one that follows the fire-bombing of Tango Urilla. Working from warrior maquettes provided by Tippett Studio, A.I artists fashioned dead warriors out of modular fiberglass sections, with black-tinted liquid urethane creating the look of charred and blackened shells.

that combined a Yagher prosthetic with bug animation. Rico leaps onto the back of the tanker, blowing a hole in its shell and dropping a grenade into the bloody cavity before being thrown off. The thorax of the monstrous tanker bug then erupts in a shower of multicolored organs.

A.I and John Richardson joined forces in *South Dakota* to create live-action elements for the scene. A.I built two hand-painted fiberglass shells — twenty-eight feet long and eighteen feet wide — that were joined together to form the back of the tanker bug, which easily supported the weight of Casper Van Dien, who was tethered to the shells by thin wire attached to a belt under his wardrobe. A twenty-foot-long tractor, capable of turning on its own axis, was hidden beneath the shells to give the tanker bug its wild, bucking movements. Tractor and shells were connected through a complicated network of metal supports, hydraulic rams and a four-axis gimbal. Two people were required to operate the assembly — one to physically drive the tractor, another inside the cab to manipulate the bug back.

Wide shots of Rico riding the bucking tanker bug were computer generated. To produce the CG human, Van Dien, wearing only underwear, posed against a grid as a series of eight rotational photographs were taken of his entire body. These reference photos, along with a full trooper uniform, were then sent to the Tippett facility, where they were utilized as visual references to build a serviceable CG copy of Troopers' leading man. Martin Meunier built the digital Rico, while animation was performed by Blair Clark.

For shots of the bug blowing up, Lucchesi and the Tippett art department created multiple transparency layers to suggest a deforming, exploding bug abdomen. "After the bug explodes," commented Brennan Doyle, "you see all of these multicolored organs inside what is left of it. The art department used a separate, gutted CG tanker model for that shot, showing its exposed innards as the tanker rocks back and forth to a halt."

The Tango Urilla attack sequence concludes with a wide panoramic view, showing the surface of the planet littered with dead, scorched warrior bodies. The live-action shot was populated with A.I's full-scale burned bugs, then enhanced with numerous Tippett elements such as smoke columns, atmospheric haze and hand-drawn 'bug damage,' such as digitally created gouges, wounds and other injuries.



The Tango Urilla carpet-bombing combined Tippett CG bugs with large-scale pyrotechnics executed on location by John Richardson and his crew. To create a napalm-style bomb run, the effects team planted large drums of gasoline and dynamite-based ground charges along a half-mile-long stretch of terrain, then detonated them sequentially. The result was a wall of fire that moved across the landscape at three hundred miles per hour.



At Whiskey Outpost on Planet P, troopers man the ramparts as warriors and flying hopper bugs storm the fort. The complex dynamics of the hoppers' fluid flying

The mobile infantry's next mission is on Planet P, where a distress signal from the Federation's Whiskey Outpost has been picked up. When the troopers find only casualties at the fort, they realize that the distress signal was a trap set by the bugs — a clear indication that a cunning intelligence is orchestrating the bug offensive. Within moments, thousands upon thousands of bugs descend on the troopers.

While masses of bugs had been featured in previous scenes, the Whiskey Outpost swarms were the largest and most complex of the show — and, in fact, were the first swarm shots taken on by Tippett Studio. “On any effects film,” explained Epps, “we like to get the big shots out of the way first. Anything you learn at the front of the schedule makes subsequent shots of the same nature a lot easier to accomplish. So we tackled the first two swarm shots in that sequence right away.”

The spectacular Whiskey Outpost swarms were comprised of nearly a dozen shots, spread throughout the sequence. The first swarm is seen after Rico and a small platoon of troopers cautiously enter the silent fort, discovering the massacred remains of the outpost's former inhabitants — bodies provided by Yagher Productions. When bugs are sighted, the camera booms up to follow soldiers running up a ramp to man the ramparts. A landscape reveal shows thousands upon thousands of advancing warriors, hoppers and tankers. “The day we shot that on location in Wyoming,” Tippett related, “we mounted a Beaumont four-perf camera on a crane and did the boom manually. The problem was that there was a thirty-mile-per-hour wind blowing, so the shot was shaky — but our schedule didn't allow for retakes. When we got back to Berkeley, we had to scan in that live-action move and digitally track and tweak every frame of it, to steady it out. That was extremely time-consuming, a real headache — and we hadn't even gotten to the bugs yet!”

Once the boom plate had been massaged and the Dynamation parameters applied, physical interactivity between the imaginary bugs and their real surroundings was introduced. “One of the reasons all of the swarm shots are so effective is that they're laced with subtle interactive elements,” offered Brennan Doyle. “As the first wave of warriors bears down on the Whiskey Outpost, the bugs kick up little dust clouds every time their feet hit the ground. To get that effect, we went through two compositing passes. First, there was an automatic software program we'd written that searched the Softimage animation files and looked for any moment where a warrior's foot intersected the ground. A grid would turn on, and the compositing department would map the appropriate footfall onto that grid. We would color-correct and fit that footfall into the plate, giving it soft edges. Next, we would put an inversion layer on top of the contact pass. That second pass was comprised of whatever elements we were going to add to the shot — things such as chips of shells coming off the bugs as they're shot, or puffs of smoke or blood. Those elements were either CG or real elements filmed against greenscreen. The dust kicked up by the warriors was a separately photographed element, as were a lot of the squib hits and gore effects you see on the bugs.”

The second Whiskey Outpost swarm scene has Lieutenant Raszak — the teacher-turned-soldier — gazing down from the ramparts of the fort at a seething sea of insects, done almost entirely as a Dynamation setup. “The bugs didn't have to move in separate paths in those shots,” said Epps. “So

motion presented the Tippett team with its most difficult animation assignment. One casualty of the Whiskey Outpost battle is Lieutenant Raszak (Michael Ironside), a war veteran who loses both of his legs when he falls into a bug pit. Kevin Yagher Productions, which contributed a number of prosthetic effects to the film, created bloody stumps that were attached to the actor at the waist, with Ironside's real legs buried in the vermiculite pit.

instead of run cycles, the animators set up ‘milling about’ cycles, which were inserted over the Dynamation-generated bug dots.”

These first two swarms had so many layers of elements and so much digital data that rendering times averaged sixty hours per frame. “Since one of those shots lasted ten seconds,” remarked Tippet, “that meant we initially had to wait months for the complete render. But after a great deal of R&D, we managed to bring those sixty-hour render times down to a more manageable twenty-five to thirty hours per frame.”

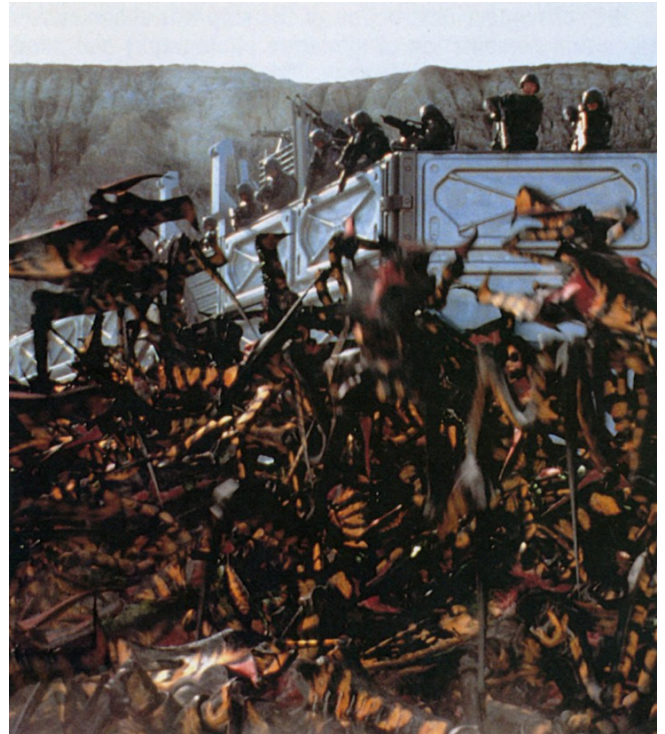
The third group of swarm shots made up a God’s-eye view of the fort being overrun by the attacking bugs, and represented another joint effort between Tippet Studio and SPI. The former composited all of the different bugs into the scene, adding an inversion layer to create dust, while the latter provided miniature photography for shots of surviving troopers being rescued by a retrieval boat. Tippet added flame spray from a tanker bug and a layer of heat distortion to suggest the extreme heat of the bug acid.



*Thousands of warrior bugs advance on Whiskey Outpost
Since neither DID nor traditional mouse-click animation techniques were viable for such swarm shots — due to the large number of bugs involved — the Tippet team modified Dynamation particle system software to create a method for efficiently animating bug masses.*

In addition to bug swarms, the Whiskey Outpost sequence was studded with a number of smaller, albeit equally impressive shots. One involved the death of General Owen (Marshall Bell), a cowardly officer who has survived the first bug attack by hiding in a meat locker. Owen's luck runs out in the second attack, however, when he is crushed by a falling hopper bug. "We called that the 'General smear' shot," stated Tippett character animation supervisor Trey Stokes. "Its dynamics — how to suggest gravity acting on the forward impetus of the falling bug, how to take the general from a kneeling position and literally spread him across the ground — were tricky. I made up a little CG ball, figured out how gravity would affect that ball if you threw it at a certain speed from the top of the fortress down at the general, then animated it into the live-action plate. After that, it was a fairly easy procedure to put the hopper bug on top of the ball, with the underlying trajectory dictating the bug's speed and angle of entry. We then wiped away the general as the hopper bug collided with him, and replaced him for just a few frames with a digital painting of a flat, stretched-out form. Finally, we replaced that mashed figure with digitally painted red smears to suggest a blood-n-guts trail."

The first hopper bug appears just prior to the Whiskey Outpost attack, as troops approach the fort through a valley. From the cliffs above, the flying bug swoops down to skewer a sergeant who is trying to radio the fort. "The hopper was one of the most challenging bugs for the art department," explained Paula Lucchesi, "because of its iridescent surface quality. It is beautiful to look at in the real world, but very difficult to replicate in the digital one. Our department worked with Doug Epps to come up with a custom, metallic surface shader. By applying that shader and experimenting with red-green-blue texture maps of varying degrees of intensity, we came up with a refractive quality on the hopper's body that was pretty successful. We used displacement to deform the surface so that light would catch certain areas of the wing more than others, giving them a wispy, delicate look. Then the



Though Dynamation sufficed for background swarms, hero bugs closer to camera were animated using the DID.



During the assault on Whiskey Outpost, the warrior bugs receive heavy backup in the form of massive, fire-spewing tanker bugs. For a shot of trooper Dizzy Flores (Dina Meyer) lobbing a grenade into the mouth of an advancing tanker, Meyer threw a prop grenade toward a predetermined target on location. When the trajectory of the grenade was judged unsuitable, the Tippett team replaced the live-action prop with a CG version.

compositing department blurred whatever environment was behind the wings to suggest their semi-translucent qualities.”

Animating the hoppers was also a complicated task. “There is an ordered chaos to anything alive,” explained Stokes, “and replicating that chaos was our biggest challenge throughout the film — especially for the hoppers. They had to be affected by small changes in wind currents as they flew, compensating for those currents by altering their flight course, just like a real flying insect. That was a very weird, subtle dynamic to simulate in a computer.” What made the job a bit easier were basic flight rules for the hopper laid down by Tippett and Hayes. “When hoppers decelerated, for example, they flared their wings out. When they dove, they adjusted the attitude of their wings. So there were definite rules — but other than that, the animation of the hoppers was mostly done by feel.”

In the course of the Whiskey Outpost battle, Raszak stumbles into a bug pit and has both of his legs bitten off. To sell the effect, Yagher Productions made a lower half-torso appliance that sat above Michael Ironside’s own chest. “We strapped it on around Michael’s shoulders and waist,” said Yagher, “which left a six-to-eight-inch gap between the fake torso and Ironside’s real body. Wearing that half-torso, Michael was buried up to his waist in a pit. Once Michael was positioned in the pit, we applied a duvetyn wrap on him with spray glue, extended the fake half-torso out in front of him, and buried that, too, just below the stump area. When Casper Van Dien and Dina Meyer jumped into that pit and pulled Michael out, the bleeding stumps were pulled up into frame. We put blood tubes and tinted latex and even real meat scraps onto those stumps for authenticity.” For the end of the pull-out — in which the character’s entire body was revealed — the Yagher group built an animatronic, lifelike replica of Michael Ironside, seen in one brief cut.

Another moment in the battle has a Tippett CG tanker bug being dispatched by Dizzy, who tosses a hand grenade into its gaping mouth. Since Dina Meyer had experienced difficulty in throwing the grenade and hitting the appropriate target on location, Tippett Studio was required to do a digital wipe on the real grenade the moment it left her hand, replacing it with a CG grenade that was then animated to fly into the bug’s mouth. The subsequent shot of the tanker’s head blowing apart was a combination of fire elements and flying bug chunks achieved either through hand animation or Dynamation.

Soon after killing the tanker bug, Dizzy herself is killed when impaled by a warrior’s claw. The special effects team created numerous impalement vests for shots such as the attack claw being withdrawn from Dizzy’s body. “For Dizzy’s impalement,” said Richardson, “we manufactured a dental alginate full-body mold of Dina Meyer. From that alginate mold, we cast up a rigid fiberglass body piece, padded with a cut-up wetsuit that was then bolted around her upper torso, with the vest hidden under her wardrobe. Then we drilled threaded sockets into that vest, into which we could literally screw the front and back halves of a broken-off warrior attack claw. Usually the difficulty with a gag like this is keeping the two ends of the impaling object in line; but the impalement vests were rigid enough to eliminate that problem.” During postproduction, Tippett Studio was requested to do digital ‘gore removal’ on the shot of Dizzy being impaled, when squibs used for the bloody puncturing of the character proved excessive.

Following the Whiskey Outpost debacle, the Fleet mobilizes to return to Planet P and capture the brain bug. Verhoeven's decision to shoot the major battles on Planet P and Tango Urilla in brightly lit documentary-like environments was one of many challenges faced by the digital film in/out department at the Tippett facility. "The often adverse weather conditions in Wyoming and South Dakota created wide variations in the color and light intensity of the plates," said film I/O supervisor David Rosenthal. "We did a lot of work, color-correcting and bringing them together so our TDs could count on a certain consistency for their lighting pass. We also put a lot of effort into closing the display loop — making sure that the scanned images displayed consistently on workstations and in video dailies, and that the values translated predictably to film for the final film-out." In order to insure the control and flexibility needed for the scanned images, Tippett Studio created a proprietary file format. "The quality of our film I/O was a tremendous concern of mine," remarked Tippett. "I knew it could make or break the rest of our work. The sheer volume of the work was daunting — over two hundred plates — and we had to build a new facility to do it. In the end, David's crew pulled it off. Our negative held up and allowed for a lot of flexibility in the final timing."

As battle cruisers hover over Planet P, plasma bugs launch their organic bombs into the skies, resulting in the destruction of the *Rodger Young* — an effects assignment executed by SPI. "The entire fleet is coming under attack during this sequence," explained Scott Anderson. "Just as the *Rodger Young* is set to jump into warp drive, it's hit by a plasma burst that literally cracks the ship in half." The plasma was computer generated, using a combination of SPI's in-house Birps software, a Wavefront particle system and Dynamation to massage the plasma software that had been written by the Tippett facility.

The subsequent destruction of the ship was accomplished through a combination of miniature photography and hand-animated, stop-motion elements. "We filmed a motion control pass of our big eighteen-foot *Rodger Young* model," Anderson said, "then broke the ship in half by placing the two separate nine-foot sections on model movers, in front of a bluescreen. These two pieces were butted up together, sheathed to hide the cracks. The model-movers literally pulled the sections apart during a motion control pass."

To reveal as much detail as possible in the starship's breakup, the two nine-foot sections were laced with interior lighting sources, stacked decks, tiny



In orbit above Planet P, the Rodger Young is split in half by an emission of bug plasma directed into space. SPI created the destruction of the massive battle cruiser by mounting two halves of the eighteen-foot model — lightly sealed at the join — to separate modelmovers programmed to pull the ship sections apart.



hatchways, tables, ceiling lights and bulkheads, made from soft metals. As the destruction progressed, the crew programmed the motion control rig to shoot multiple passes over the two destroyed sections. “In between each of those exposures,” related Anderson, “two stop-motion animators, Peter Kleinow and Paul Jessell, went in

To incorporate even more detail into the breakup of the big ship, stop-motion animators went in on a frame-by-frame basis to manually bend and twist specific areas of the model’s exposed interiors. Pyrotechnic explosions, practically photographed, were composited into the final shots.

and physically manipulated the various decks and surfaces of the two inner, exposed sections of the Rodger Young, bending bits of metal to make it look like decks were ripping apart, and so on. So in a sense, it was go-motion; the small details were executed on a frame-by-frame basis, while the overall moves were done via motion control. For the final moments, when the two halves of the ship explode into nothingness, we blew up three Rodger Young pyro models. Once everything was digitally composited, the separation passes, model-mover shots, pyrotechnic effects and stop-motion sectional shots gave a very realistic, random feel to the Rodger Young’s death. It was a pretty impressive way for that ship to go out.”

SPI also supplied shots of a lifepod being piloted by Carmen and Zander onto the surface of Planet P after jetting away from the exploding Rodger Young. Streaking across the alien landscape, the lifepod impacts a small mountain peak, bounces upward, punches through a soft-sided mountain, and shudders to a stop within the planet’s subterranean bug tunnels. A shot of the pod flashing across the barren landscape entailed shooting seven Vistavision scenic plates on location in Wyoming. Later, these were digitally stitched together to form what was called the ‘quilt shot,’ a supersized Planet P backdrop that featured a computer enhanced camera pan and a replacement sky. A CG lifepod was inserted into that landscape for shots of the lifepod rebounding off the small peak, with a miniature pod filmed for the moment of impact.

Carmen and Zander are trapped within the bug tunnels, their limbs impaled by bug claws, as a small army of warriors awaits the arrival of the brain bug. The sequence featured both real-time DID animation and the stop-motion variety. “Throughout that sequence,” noted Trey Stokes, “you see a crowd of warrior bugs in the background, packed together like agitated cows, howling and barking and doing all sorts of behavioral cycles. Because of the nature of those shots, we were able to just grab ahold of the real-time armature and spend a couple of days cranking out the crowd performances.” Foreground warriors in the same scene were animated via the stop-motion DID.

Carried by a team of chariot bugs, the brain bug makes his appearance in the tunnel. The brain bug was built both as a practical puppet by A.I and as a computer model by Tippet Studio. Due to the closeup nature of the practical shots, A.I was required to build only the head, mounted to a boom arm, extending out the back, for gross movements. After studying drawings, computer models and a maquette of the brain bug — all supplied by Tippet — A.I proceeded to build the full-scale puppet. The process began with the creation of a polyurethane sculpture, complete with pebbly skin texture. Molds cast from the sculpture produced fiberglass pieces that were joined together to form the underskull. “Because of the enormous size of the brain bug’s head,” noted Alec Gillis, “we had to do it in pieces that would fit in our ovens.” When completed, the head measured twelve feet tall, ten feet wide and ten feet deep.

For the skin, sculpted foam latex sheets were cast separately and painted. Fabric was laid behind the latex during the baking process to add strength and allow the crew to stitch the large sections together. A separate skinflex piece was bolted to the underskull plate mechanisms that would articulate the brain bug's face. "Craig Hayes did a remarkable job designing that face," said Gillis. "It was detailed with long, thin, paddle-like appendages near its mouth, called feeder claws. It had eight eyes and a huge, vertically slitted mouth. All of those things had to be replicated in the full-size puppet. We made the feeder claws out of fiberglass, operated by radio control mechanisms. The eyes were cast of high-gloss urethane, misted with a silicone oil during filming to make them reflective and alive. The sphincter-like mouth was also made of skinflex. We attached air bladders on either side of the underskull, which could be manually operated by little hand bellows to make the brain bug look as if it was pulsating." The large underskull — which had been configured to wrap three-quarters of the way towards the back of the head — provided an ample-sized opening for as many as five operators to climb inside and manipulate a series of puppeteering rigs.

Creating the real-time equivalent of the brain bug's rippling meat wave effect fell to mechanical designer David Penikas, who built an endless conveyor belt system, measuring eight feet long and two feet wide, that followed the curvature of the bug's upper skull. Two rollers with gripping servos were positioned at the puppet's brow area and towards the back of the head, connected by the belt, which was adorned with crescent-shaped pillows. A simple DC motor, equipped with a speed controller, ran the conveyor belt, producing a rippling effect as the pillows made contact with the soft skull covering.

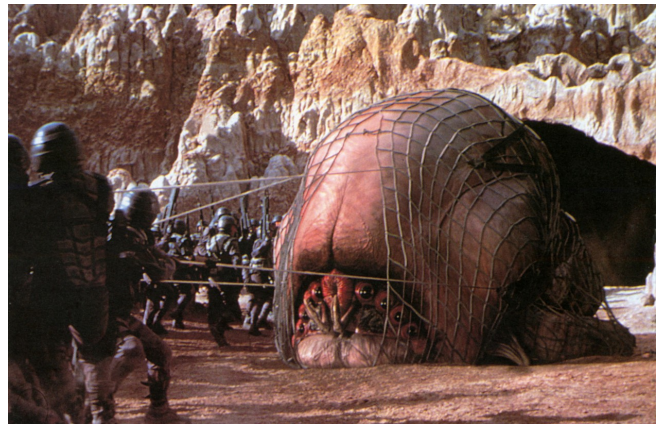
Cable mechanisms were also used for the brain bug's palps — spiky appendages that emerge from the creature's mouth. "We made a number of triple-jointed, cable-controlled palps," said Yuri Everson, "operated from inside the puppet head, through what looked like a little T-shaped motorcycle handlebar." The exterior of the palp was made of translucent vacuform material that was airbrushed. For a shot of Carmen slicing off the tip of one palp with a knife, a precut tip was applied with superglue, and a hollow inner tube inserted, through which colored methocel was pumped, suggesting a spattering of the bug's fluids. "The final type of brain bug palp we made wasn't attached to the bug at all, but was mounted instead on a C-stand. It was also translucent and jointed, but it had a larger hollow tube inside and two tips that we could superglue onto the end of it. We used this particular palp for the shot of it hitting and embedding itself in the top of Zander's head. We switched tips for the subsequent shot of the palp sucking Zander's brains out."

The brain-sucking effect required collaboration between A.I and Kevin Yagher Productions.

"Working alongside A.I, we did that in two stages," commented Yagher technician Bryan Blair. "For shots where it's obviously actor Patrick Muldoon looking horrified, we came up with a mohawk-type wig for him, with a fake silicone wound attached to the top of it. A.I took off the tip of one of the hollow vacuformed palps and attached it to our fake wound and hair appliance. At the same time, we'd hidden flexible, hollow plastic tubing, about an inch in diameter, under Patrick's hair. That tube trailed down behind his back and into a plastic bucket, where we'd deposited this sausagelike rope of silicone 'flesh' that was attached to a string and drenched in stage blood. We ran the string out the opposite end of the tubing and into A.I's hollow spike. On 'Action,' Patrick started to grimace while I pulled the string, yanking the sausages up through our hidden tubing into the translucent spike, making it look as if Zander's brains were being sucked through the palp."

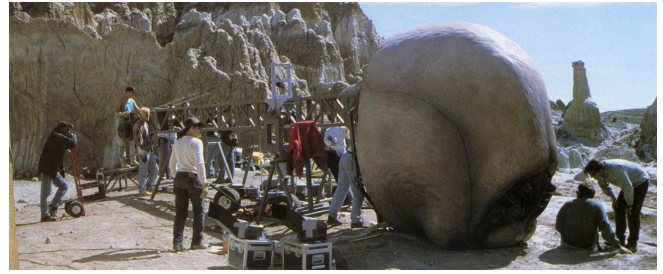


The troopers' fortunes take a turn for the better with the capture of the brain bug, designed to look like a giant, rippling head, with an extending appendage that can penetrate a human skull and literally suck its brains out. A full-scale brain bug head puppet, built by A.I., was employed for a scene in which the bug prepares to lobotomize Zander.



Wider views of the brain bug were realized digitally by Tippett Studio. Among the challenges of the brain bug capture sequence was computer generating a restraining net that would look as if it were making firm contact with the bug, without imbedding itself beneath the surface of the digital model.

Subsequent scenes showing Zander's eyes rolling back and his cheeks hollowing out as the brain bug empties his cranium required two puppet heads. "We did two lifecasts of Muldoon's head in dental alginate," observed Yagher animatronics technician Evan Brainard, "each with a different expression. One was this wincing, painful look he gets when the spike first slams down on his head. The shot itself was achieved by mounting a pointed palp on a C-stand, then physically slamming it down into a hole we'd prescored on the top of this wincing dummy's head. The second head had a death look to it. Zander's mouth is open, and then a through the use of cables, servos and air bladders a his cheeks are sucked in while his eyes roll back, to make it look like the brain bug's spike has applied a lot of suction to the head area. That second Zander casting was the more elaborate of the two. The end result was mounted onto a half-torso that had a fiberglass understructure. The head itself had painted silicone skin and acrylic eyes, and the whole thing was puppeteered from below frame."



On location in Wyoming, the practical brain bug is readied for filming. Limited forward movement was achieved by mounting the puppet on a dolly track.

Wider, more dynamic scenes of the brain bug were accomplished with a CG version, modeled by Martin Meunier and Merrick Cheney, and animated by Jeremy Cantor using key-frame techniques. Articulation of the brain bug included the meat wave rippling effect, achieved largely through procedural software shaders, written by Doug Epps for RenderMan. "The tricky part," noted Trey Stokes, "was making sure that the meat wave movement was adjusted to the overall animation of the brain bug, so that the wave didn't change the character of the bug's animation. One way Jeremy approached that was purely procedural a he got in there and digitally grabbed the brain bug's flesh and warped it all over the place. For the actual wriggling mounds of flesh, Jeremy used another shader, created by Doug Epps, called 'Blorph.' If Jeremy wanted one of the brain bug's cheeks to hit the ground and jiggle for a second, Blorph would allow him to do that. That piece of software, combined with the meat wave effect, gave the CG brain bug a convincing look of weight and fleshiness."

The brain bug's entrance is signaled by the appearance of chariot bugs a four-foot-long attendants that carry the undulating brain on their collective backs. In the animation, the Tippett crew tried to impart the sense that the chariot bugs were not only transport for the brain bug, but also his worshipful servants. "They adore the guy," Stokes commented. "We tried to suggest that by animating moments where the chariot bugs' feelers are touching and stroking the brain's body. To suggest that they are also a form of bodyguard, we animated one to stand guard over a rifle that Zander has dropped. It is a subtle throwaway, but it's there."

The brain bug is ultimately captured, then dragged from the mouth of the tunnel, encased in a net. The netting presented the Tippett crew with its most taxing challenge. "The problem was the point of contact between the net and the brain bug," explained Paula Lucchesi. "The CG net had to be close enough to the surface of the bug that it wouldn't look as if it was floating; but far enough away so that it wouldn't appear that the net was going through the surface. We also had to be careful

when casting shadows of the net onto the brain bug's body so that they wouldn't emphasize any contact problems."

"There really wasn't an easy way to do it," Tippett elaborated. "Solving the net problems demanded a close collaboration between our CG model and animation departments, and a lot of elbow grease. It was a tough nut to crack, but we did it. Jeremy Cantor, in particular, was great at finding just the right level of procedural and texture-based animation to make the CG brain bug look like he was encased in that net, while at the same time making sure that the bug did not absorb the netting beneath the surface of its skin."

For a panoramic crowd shot near the end of the movie, just after the brain bug has been captured, Tippett Studio made use of its motion capture suit. "All of the cheering troopers were CG guys," commented Stokes, "eight hundred of them, in fact. We generated a bunch of performances by simply hooking one of our guys up to a motion capture rig and having him perform different cheering actions. Those were input in the computer, multiplied and distributed among the CG crowd."

In the months prior to *Starship Troopers*' November 7 opening, TriStar Pictures launched a massive advertising and marketing blitz. Despite all best intentions, however, the picture's performance at the boxoffice was less than spectacular. Audiences, for the most part, were enthusiastic about the movie's action scenes and visual effects; but there was tepid response to the satirical treatment of Heinlein's novel. Many critics were disdainful of the performances of the film's youthful cast, or put off by Verhoeven's unflinchingly graphic portrayal of futuristic combat.

But, unquestionably, the movie resonated within the effects community. "Phil Tippett's work in *Starship Troopers* is revolutionary," asserted Alex Funke. "I really mean that. Tippett Studio pulled off things that had never been done before. Nobody had ever attempted a film with 220 computer generated shots, especially such photorealistic ones. This movie was a gigantic step forward. Whenever I'm asked what I think of the CG work in *Starship Troopers*, I have only one thing to say a *Jurassic Park* isn't the benchmark anymore."

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CLONING ALIENS

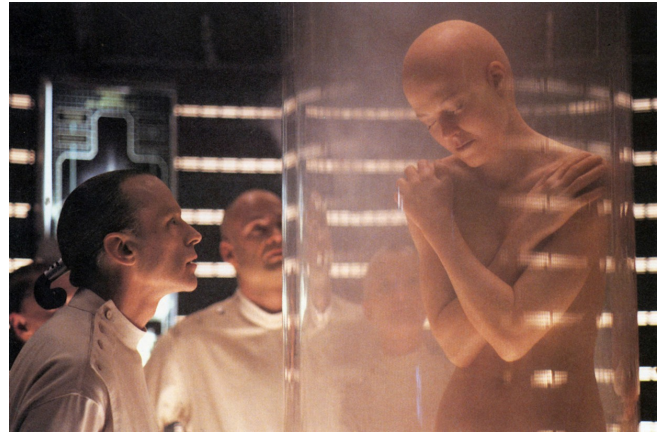
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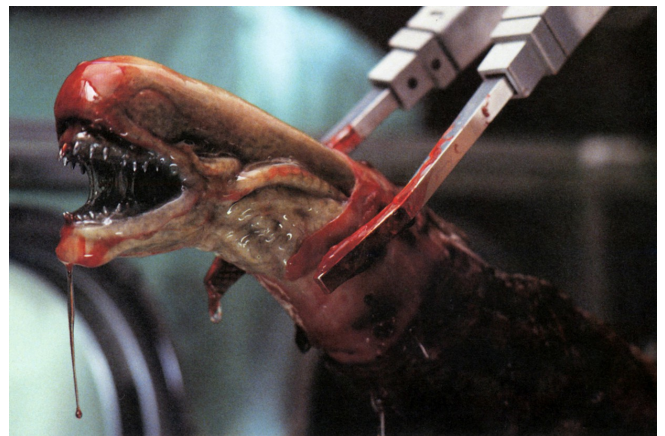
Almost twenty years ago, when audiences first thrilled to the nightmarish images of *Alien*, not only did the groundbreaking creature effects evoke astonishment, so too did the plucky determination of the film's heroine warrant officer Ellen Ripley. Ripley would serve as a prototype for a new generation of gutsy action heroines; and Sigourney Weaver, whose film career was launched by the defining role, would subsequently reprise the character in two sequels *Aliens* in 1986, for which she earned an Academy Award nomination, and *Alien3* in 1992. No wonder, then, that Twentieth Century Fox refused even to consider undertaking a fourth installment in the franchise unless the actress' involvement was assured. That proved no small feat for screenwriter Joss Whedon, since Ripley, having herself been impregnated by an alien embryo, had leapt to her death at the conclusion of *Alien3*. Nevertheless, by 1996, Fox had its screenplay together with assurances that Weaver would return under the direction of Danny Boyle, who had recently completed the widely acclaimed *Trainspotting*. Just months into preproduction, however, the fiercely independent Scotsman bowed out, having determined that his sensibilities did not mesh with the demands of a big-budget effects production.

Still seeking a 1997 release date and committed to keeping the *Alien* franchise fresh through the employment of up-and-coming talent with new perspectives the studio turned to French director Jean-Pierre Jeunet who, with his longtime partner Marc Caro, had turned heads with the imaginative and award-winning fantasy *The City of Lost Children*.

Alien Resurrection as the new film would be titled presented Jeunet with a significant personal challenge. The movie was far more complex, especially in terms of effects, than his previous



Reluctant to commit to a fourth installment in the enduring Alien franchise without actress Sigourney Weaver in her pivotal role as Ellen Ripley, Twentieth Century Fox resorted to cloning as a plot device to reprise the heroic character who died in the previous film for its current entry, Alien Resurrection. In the film's opening sequence, Amalgamated Dynamics Incorporated tagged by director Jean-Pierre Jeunet to create the creature and makeup effects provided a nonarticulated likeness of Weaver for shots of a Ripley clone growing to maturity under the watchful gaze of scientists.



Implanted in Ripley before her death, an alien queen infant, built and puppeteered by A.I., is surgically extracted from its clone host.

projects. It was a \$70 million picture sponsored by a major American studio; and it would be filmed in Hollywood, a place that was both culturally and geographically alien to him. To complicate matters further, Jeunet spoke virtually no English.

In *Alien Resurrection*, genetic engineering and a surviving drop of blood provide the means to bring Ripley back from the dead along with the alien embryo inside her. After two centuries of effort, earth's military-industrial complex intent on acquiring the ultimate bioweapon has finally yielded a Ripley clone. In a remote and secret laboratory aboard the spaceship *Auriga*, scientists extract an alien queen embryo from the clone host, and proceed to breed its warrior offspring. But all is not progressing as planned. The genetic cross-breeding of the two species has produced alien progeny with heightened intelligence and a Ripley clone with disturbing alien characteristics. Predictably, the cunning aliens escape from confinement in the laboratory, quickly overrunning the huge ship as they prey upon the crew. Though tainted with alien DNA and unsure of her own humanity, the cloned Ripley joins forces with a band of human survivors to escape the doomed ship and destroy the deadly infestation.

With a story calling for extensive visual effects, the mandate for *Alien Resurrection* was to top all three of the previous franchise entries. In Spring 1996, Jeunet arrived in Hollywood to reenergize the stalled preproduction and prepare for principal photography. The studio already had scrapped its plans to begin shooting that summer; but the rescheduled November 1996 start and planned summer release later moved to November 1997 still required an aggressive production pace.

For his first American film, Jeunet elected to import a number of key collaborators who had worked with him on earlier French productions. Among them were director of photography Darius Khondji and visual effects supervisor Pitof, a leading figure in the Paris effects house Duboi, which had contributed substantially to *The City of Lost Children*. For *Alien Resurrection*, the firm was tapped to handle digital compositing and other chores. "I've known Jean-Pierre for more than ten years," Pitof remarked, "and we've worked together on many projects. We are a team in France, a kind of family, so I know what he wants. It was important to make this job comfortable for Jean-Pierre, so that he could deliver his particular vision and artistic look." Pitof was also a valuable asset to Jeunet in terms of communication, especially at the beginning. Although the production had engaged the services of an interpreter, Pitof and other bilingual Frenchmen on the team were essential in relaying a deeper understanding of the director's desires and intentions to the American crew. Communication problems eased with the wrapping of main unit cinematography, by which time Jeunet's English had improved markedly.

Working in tandem with Pitof was Erik Henry, an alumnus of Dream Quest Images. Supporting both supervisors in the critical role of visual effects producer was Susan Zwerman. In September 1996, the visual effects team set up shop in the small Churchill Studios complex a facility that was close to the Fox lot, where principal photography would take place, and also near the former Hughes Aircraft plant where the show's miniatures would be filmed. The divergent backgrounds of Henry and Pitof dictated a natural division of labor: Pitof would oversee on-set duties primarily, interacting with Jeunet and Duboi during principal photography, while Henry would work with Duboi and other effects vendors as shots were generated, as well as with the miniatures unit at Hughes.

To prepare for the shoot, the production concocted a 'bible' whose pages had storyboards for the entire movie on one side and corresponding sections of the script on the other. The end result, a kind of graphic novel, represented Jeunet's precise vision for the film, from which he would deviate very little once production started. The breakdown of effects, based on that bible, projected a shot count of 120 a number that would grow to 205 by the end of production, due primarily to a third-act rewrite executed well into the main unit shoot. Some shots particularly those slated for the miniatures unit were previsualized in computer graphics roughs or through foamcore mockups shot by Jeunet with a lipstick video camera.

Faced with an August 15 delivery deadline for miniature and live-action elements even after the movie's release date had been pushed back to November the effects team determined that postproduction would have to be up and running concurrent with production. "We got the editor to give us plate material starting in December," noted Erik Henry, "when we were just getting through the first weeks of shooting. That's highly unusual, but it enabled us to get a head start on things that we knew would take a long time, such as the CGI alien."

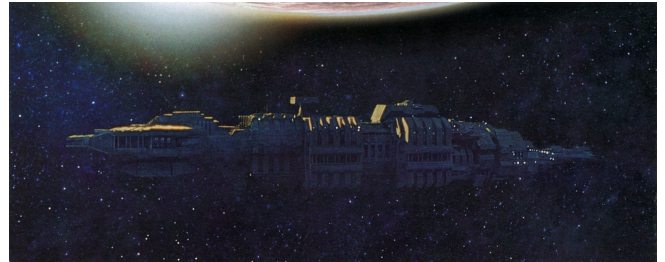
Responsible, in varying degrees, for 133 shots, Duboi established a fifteen-man team in Los Angeles, overseen by effects producer Edouard Valton and manned by Paris-based personnel who committed to three-month 'tours of duty' on a rotating basis. The French company collaborated with Fox to set up the L.A. facility, installing their Dutruc software in Silicon Graphics workstations and loading revisions as they became available from Paris. "Our software is always evolving," noted Valton. "As soon as we knew for sure that we had the show, we rushed to make changes necessary to run the code on the SGI Challenge processor and also to use the latest media for saving files, which were much faster than what we had. Throughout the show, if there was an occasion when we felt that some Dutruc tool was not efficient enough, we would call Paris and they'd solve the problem quickly, then encode the stuff and send it to us via the Internet."

As Duboi was setting up shop in Los Angeles, Alec Gillis and Tom Woodruff, Jr., of Amalgamated Dynamics Incorporated who had been approached early on to handle the production's all-important creature and makeup effects geared up at their shop in Chatsworth. The A.I team was well-acquainted with the demands of the *Alien* series, having performed similar duties for *Alien3*. Gillis and Woodruff had also worked on *Aliens* while on staff at Stan Winston Studio.

The tight scheduling of the newest production was cause for concern. "Production told us that, due to Sigourney's schedule, we would have to be ready to start shooting with a very short prep," Woodruff remarked. "We did a breakdown of the script and realized that the job was enormous just way too big. And then that original shooting date came and went. Unfortunately, when they came back later, it was the same story. We were very worried about having enough time to do the job right. We knew that if we rushed it, the work would look bad, and we'd be the ones who ended up hurt. So we outlined some cuts, identified what was needed up front when Sigourney had to start, and pushed all the other stuff to later in the schedule. It was understood that we'd be showing up literally two days before shoots with very little time for tests or changes."

Although the entire A.I team rose to the challenge of the compressed preproduction schedule, both Gillis and Woodruff feared they were setting an unrealistic, and ultimately damaging, precedent. "Preproduction schedules are getting shorter," Gillis remarked, "and we're expected to produce

these creatures faster and faster. But artists can't perform at top speed all the time. The constant demand to do everything quicker tends to burn people out. And in this digital age, with so much wonderful stuff possible on computer, we can't afford sloppy work. If we drop the ball, it looks bad for our art." Diving into the mad schedule, A.I commenced work in May 1996, accelerating efforts and assigning additional people to the show as shooting neared. More ambitious than any of the previous *Alien* outings and, in fact, the largest A.I had ever taken on the project eventually necessitated a move into larger workspace and an expanded crew of seventy.

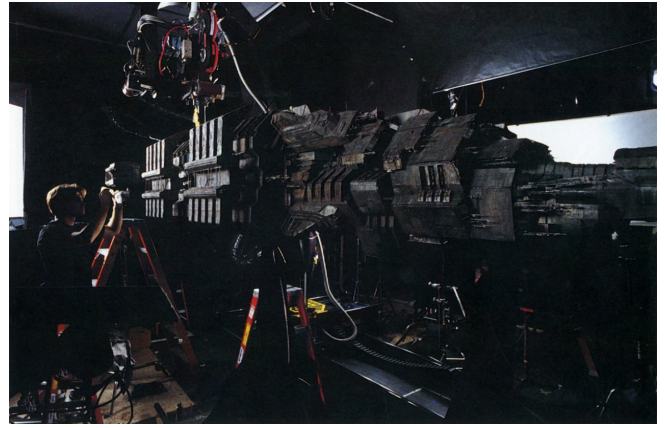


The top-secret cloning experiments are conducted on board the Auriga, where earth scientists are intent upon creating the ultimate bioweapon through controlled breeding of the alien queen's warrior offspring. To depict the ship and other spacecraft called for in the script, an array of full and partial miniatures was constructed by Hunter/Gratzner Industries and photographed in Los Angeles, then composited by Paris effects house Duboi.



On a greenscreen stage in an old aircraft hangar, a model of the Betty a commercial freighter engaged by the Auriga scientists to deliver human sacrificial subjects for their ghastly experiments is mounted on a pivoting rig in preparation for filming.

Alien Resurrection opens with images of the Ripley clone growing to maturity. Nonarticulated dummies of Weaver and a nine-year-old child were sculpted for the scenes by Steve Wang at A.I., with Duboi later executing a morph between the two faces, utilizing Elastic Reality and Matador. The Ripley dummy was made from a casting of the actress left over from Alien3 and a mold taken from a body double. Painted by James Hogue and Jordu Schell, the dummies were to be filmed inside a fluid-filled plexiglass cylinder built by special effects coordinator Eric Allard and his All Effects team which handled all of the on-set effects but the refractive properties of the water and the curvature of the tube created an unflattering distortion of Weaver's features. To resolve the aesthetic problem, the tubes were photographed dry, with smoke inside to create atmosphere. Duboi subsequently added digital bubbles to the dry-for-wet elements.



Mechanical effects designer Dale Tanguay reads the Auriga for a motion control pass. Filming of the models was overseen by visual effects supervisor Erik Henry and effects director of photography Rick Fichter.

After the Ripley clone has reached maturity, the queen infant is removed surgically to prevent it from erupting from its host. For the operation, A.I created a false chest shell sculpted by Jeffrey Buccacio, painted by Jim Hogue and mechanized by John Lundberg that was attached to Weaver, creating a five-inch-thick layer of simulated human bone and tissue that covered an articulated fetal chest-burster puppet. During filming of the scene, Weaver lay in a specially built tub, fashioned by All Effects, that positioned her body below the level of the table surface so that only her head, arms, shoulders and legs were visible. A.I then affixed its silicone appliance, which extended from the actress' collarbone to her knees. Pre-slit and backed with tabs connected to pull-wires along its length, the false chest was rigged to open when the laser scalpel passed over it. Duboi enhanced the effect with CG smoke, and cleaned up unwanted elements along the length of the incision.

In subsequent shots, silicone tendons and veins are cut, and mechanical grippers are seen reaching in to extract the alien infant, encased in a placental sac that splits and peels away a visceral image created with a thin silicone membrane, pulled from off-camera. A subsequent shot of the creature awakening and beginning to squirm was achieved with a larger-scaled chest-burster, set in oversized mechanical claws matched to the proportions of the puppet. The ruse was necessitated by the fact that time and money constraints afforded the construction of only one articulated chest-burster, built by Luke Khanlian and mechanized with cables running out the tail. To create the effect of the fetal alien thrashing about as it is placed in a specimen container, a simple wire was attached the only mechanical means afforded by the limited space.

The clandestine breeding activities are conducted aboard the Auriga, a 12,000-foot-long vessel in orbit around Pluto. To obtain human hosts for the alien embryos, the ship's crew allows a small commercial freighter, the Betty, to approach and dock. Crewed by space pirates, the freighter delivers eight hapless victims, kidnapped while in hypersleep and still dormant within their cryochambers. For the spacecraft exteriors, both Erik Henry and Pitof were convinced that miniatures would be qualitatively superior to computer generated models, given the time and cost

factors involved. Enlisted to fabricate detailed miniature representations of the spaceships, plus larger-scale segments of both spacecraft and the Auriga's docking bay, was Hunter/Gratzner Industries.

Based on concepts provided by production designer Nigel Phelps, construction of the ships began in November 1996, after a two-month period during which the designs were finalized. "The art department gave us some conceptual blueline drawings and color renderings," commented Matthew Gratzner. "We also did our own conceptual and working drawings that we brought back to them for approval. They were very receptive to our suggestions on details and how to build the miniatures and they were very much aware of the time and money it took for construction. As a result, the changes on this show were nothing compared to what we normally encounter. It wouldn't be unusual for production to come back, and say, 'Oh, by the way, the spaceship needs to be twice as long.' Nothing like that happened on this show. All of our miniatures for Alien Resurrection looked exactly like the conceptual designs."

A Hunter/Gratzner crew of about thirty constructed eight miniatures in three and a half months, delivering them to the Hughes hangar stage by January. For the immense Auriga, a 1/1000-scale, twelve-foot-long model was fabricated, weighing in at approximately two hundred pounds. Fashioning the ship around a rigid steel frame, with top and bottom mounting points, modelmakers used cast urethane sheets for surface detail, and etched stainless steel for a final outer layer consisting of thin grillework. To provide practical illumination, between 10,000 and 15,000 fiber optic strands were laced throughout the ship, and blue-white quartz halogens were mounted inside the engines.

The Auriga's docking bay and the Betty were built to matching 1/32-scale so that they could be filmed together in-camera, without the need for compositing. A small-winged vessel, the Betty measured roughly five feet by five feet, and was built on a steel skeleton with six mounting points. The miniature had five axes of motion, including two rotating engine nacelles on articulated arms. Its movements were driven via stepper motors commanded by an on-stage motion control system.

The docking bay miniature was a wall-like structure, thirteen feet tall and stretching eighteen feet in a shallow convex curve. Extending from the structure were docking piers with grapplers and magnetic coupling arms, two of which could be articulated by stepper motors for shots of the Betty being secured. A concealed post or motion mover arm could also be installed through the wall into the aft mount of the model. Since the docking bay was painted a dark gray, which did not show up well in the dim stage illumination, thousands of tiny lights served to define its shape. Initially, the Betty miniature was fitted with opaque cockpit windows to avoid the need for matting in a set and actors. But the solid windows proved unsatisfactory, working against the illusion of scale. "With the art department's help," stated Ian Hunter, "we sketched out and built a cockpit really fast, putting in clear window panes. Whenever we did beauty shots, we would obscure the windows with black cards so as not to get any reflection. Then we had orange cards for passes where reflections needed to be composited onto the glass of whatever environment the Betty was in."

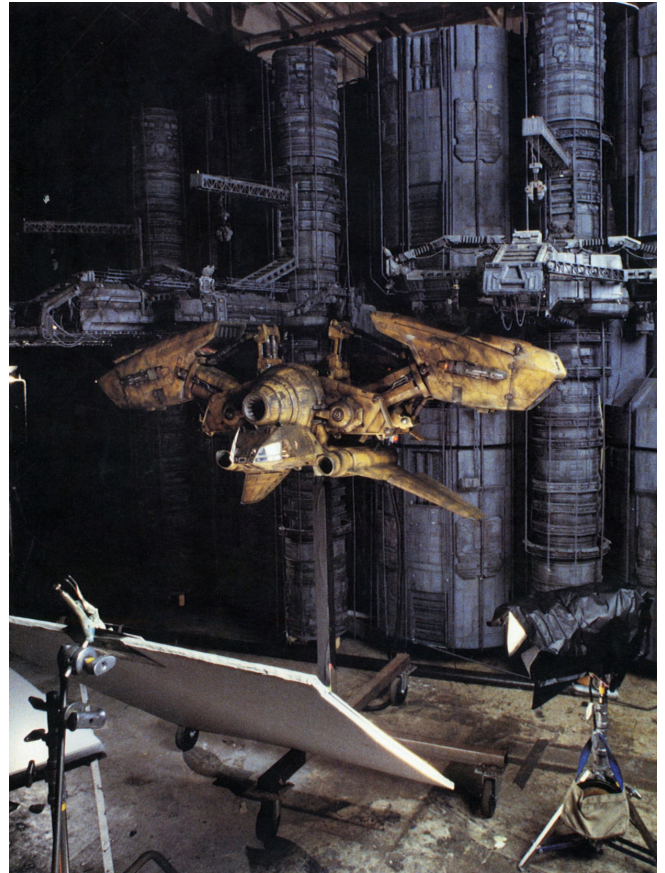
Some shots of the docking bay were extended with digital matte paintings, rendered at Duboi by matte artist Jean-Marie Vives. Working out of his studio in Paris, the artist would send these and other digital matte paintings to the Duboi contingent in Los Angeles via the Internet. Vives also traveled to the States on several occasions to photograph sets and miniatures with a large-format still camera, creating a library of reference material that he could rely upon while rendering the twenty matte paintings required for the film.

In one docking shot, the Betty is viewed from below, rising toward the distant pier, with seemingly endless tubes, columns and walls of the bay extending up into the darkness. Although portions of the wall were rendered via matte painting, much of the imagery was the existing miniature, laid on a motion control track and moved incrementally to produce elements that could be digitally lined up and fitted to the top of the previous, closer image of the wall.

Brought in to serve as visual effects director of photography for the miniatures unit was Rick Fichter, who had performed similar chores for Boss Film Studios during *Alien3*. Although a May wrap date was assigned, even with a second unit added late in production miniature photography was not completed until mid-June. "In terms of sheer difficulty," commented Erik Henry, "those shots were the most challenging of the show. Some went on for hours shift after shift because of the nature of the exposures and the multiple passes required for the various lights and mattes. In compositing, that gave us up to twelve layers of elements, if you include matte paintings, each of which had to be tweaked a little to make the final product just right."

Other complications included the fact that the ground upon which the Hughes hangar stood was unstable and tended to play havoc with the extremely subtle and fine-tuned motion control moves. "Oddly," said Fichter, "we had a lot of problems with earth movement at the Hughes location tiny shifts and earthquakes. Every so often, we'd find that our tracks were out of alignment or had buckled. So we had to keep checking and readjusting everything." Motion control equipment was provided by General Lift, which made available its latest Scimitar unit running advanced Kuper software.

Jeunet and Darius Khondji shared a specific vision for the lighting of the miniatures, intended not only to set a foreboding tone, but also simply to make the spaceship photography different from



The Betty is positioned in front of a partial model of the Auriga's massive docking bay for a sequence of shots depicting the freighter's arrival with its human cargo. Hunter/Gratzner fashioned both models in matching scale to allow as much in-camera work as possible. Additional elements, later composited into the docking shots by Duboi, included extensions of the bay, rendered by digital matte artist Jean-Marie Vives.

that seen in other films. “They were looking for a very dark, brooding quality,” Fichter remarked. “Darius spoke about this deep-space omnidirectional wrap lighting, which we came to call the ‘god light,’ with almost no fill at all. He also wanted a subtle rim lighting that we would just kiss in. We built a twelve-by-twelve-foot fluorescent light source that we directed through bleached muslin. While it had direction, it was extremely soft. But we found that if we got too soft, we lost the planes of the ships, and they just looked like silhouettes. So we explored practical lighting. The biggest problem was that all of the models had very complex angular surfaces. When a surface was shifted, it would kick light back and fight the whole design of the lighting scheme. We eventually hit on bouncing normal incandescent light off of a black surface, and built a giant tent out of black-painted aluminum foil, blowing maxi-brutes into it with these intense bulbs. We were using a high-speed film, but our depth of field demands were so extraordinary that we needed a lens f-stop of 22. Plus, the heat buildup on stage was such that we could only keep the lights on for as long as the takes lasted.”

The high temperatures on stage led to eventual modifications of the Auriga model just one of many miniature refittings required once the shoot was in progress. “Modelmakers get very attached to their miniatures,” Ian Hunter commented, “so they hate it when I am more than willing to take a saw or drill and start cutting holes here and there to put in additional lights or something. But models are products that’s all and we have to do whatever is necessary for the sake of getting a shot.” In the case of the Auriga, that amounted to air conditioning the model so that it could withstand the heat of the lights on stage. “The camera passes were tremendously long on the Auriga. A normal miniature shot is five or six seconds on screen; but some of the establishing shots of the Auriga and the Betty ran sixteen to eighteen seconds. The beauty passes needed four-second exposures per frame, or longer for the very dim lights. So if you add up all the frames, most of these passes took about forty minutes. With multiple passes, some of the shots took eighteen hours to complete. Since the Auriga was a black ship and retained heat very well, we were just baking it like a potato the cast resin skin actually began to ooze. We brought in a few air conditioning units to blow cool air onto the model, but we couldn’t cool the entire stage because the moving air would have blown around the smoke we were using. We’d also begun incrementally boosting our internal lighting to help reduce exposure time. That, of course, made for even more heat inside the model, requiring extra fans. The fans, in turn, added an internal heat source; so we ended up running air conditioning hoses into the Auriga.”

Another stumbling block in the miniature shoot came when Fichter presented Duboi with his initial series of test elements for compositing. The French firm, accustomed to a difference matting process unlike American companies which usually rely on contrast matting procedures protested that the elements provided were not suitable for the Dutruc compositing software. Consequently, the miniatures crew had to adjust its methodology. “Duboi could not pull a black core matte and a female, or a male and a clear background,” said Fichter. “What they required was a combination female and male matte, with color in the opposing matte. They also needed a spill matte what we would call an internal core matte. So if we had a redscreen background as we often did we would have to have a blue interior core matte. We had to photograph one side of the matte, backwind, and use digital blue tubes to expose the core matte, overexposing the blue to get rid of any contamination that the red might cast on the model. But we weren’t sure we could get tight-fitting

mattes on a blurred pass going this way. The complexity of this matting system was incredible. It took a lot of extra rigging between passes, and we were falling behind schedule. So the decision was made to go back to greenscreen for most of the last shots, using finer-grain film stocks to limit the adjacency problem.”

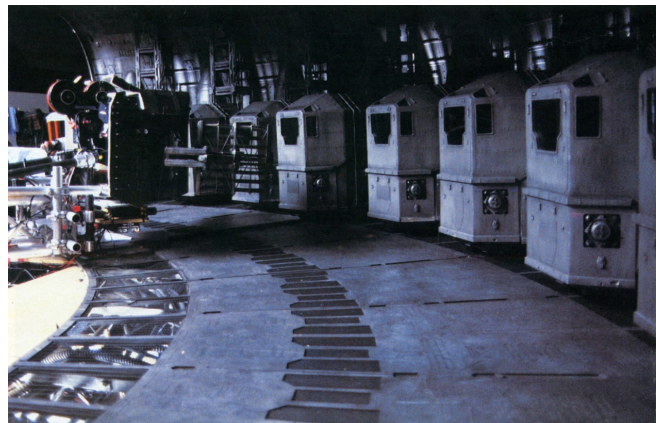
The adjacency problem was one cinematographers had been experiencing with Kodak T-Max technology film stocks during greenscreen compositing, finding that they tended to generate artifacts or irregularities in the matte edges. Bluescreen which uses the fastest, but grainiest layer of the film emulsion to produce mattes only exacerbated the adjacency. However, redscreen which accessed the finest-grain layer in the film, albeit the slowest yielded high-quality mattes while minimizing adjacency. As a result, Fichter enlisted Composite Components to set up an ultraviolet front-lit red process screen on the miniatures stage.

With the arrival of the pirates, the Ripley clone is quickly sought out by Call (Winona Ryder), a mechanic from the Betty crew, who learns of the clone’s presence on board the Auriga. Selling the illusion of Ripley as a part-alien, part-human hybrid was achieved through a combination of performance strategies and subtle special effects. Sigourney Weaver consulted Tom Woodruff about alien mannerisms, and adapted some for the character. In addition, the actress’ personal makeup artist, Linda DeVetta, prepared subtle Dermaplast appliances, including elongated black fingernails and scars on her back ostensibly the result of surgery to remove four alien appendages. A number ‘8’ tattooed on her forearm testified to the fact that seven cloning attempts had preceded her.

Unaware that the alien fetus has been extracted from Ripley, and fearing a renewal of the xenomorph threat, Call slips into Ripley’s sleep chamber and attempts to slay her with a knife. Demonstrating her alien capabilities, Ripley presses down on the extended knife point so that the blade passes completely through her hand. In filming the live-action sequence on stage, a common spring-loaded prop knife was used. Rings of orange tape on the blade, seen only by a video camera at 90 degrees to the main camera, would later enable a team of digital animators from VIFX including supervisor Richard Hollander, technical director Michael La Fave and digital effects supervisor Antoine Durr to judge the rate at which the knife was collapsing. Using this data, the team created a computer generated 3-D knife blade emerging from the back of Ripley’s hand, while also animating the surrounding flesh to pull and part realistically. The reverse was then done as the knife was withdrawn; and the blade’s sheen was dulled to show the effect of Ripley’s acidic, alien blood. Wisps of smoke emanating from the wound were produced through a combination of practical and computer generated smoke elements, composited by Digiscope to create a seamless illusion.

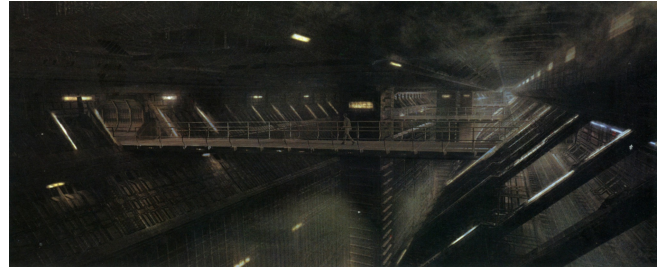


Modelmaker Jim Key fits together pieces of a rotating science station at the center of the Auriga's torus-shaped observation room, where scientists study the aliens. Used for wide shots of the setting, the miniature, built by Hunter/Gratzner, also featured a series of alien containment cells along a circular perimeter wall.



Aligned as though shooting through a window in the central hub, a camera films one of the containment cells, which has been mechanized to extend out and link up with the science station.

In a scuffle with members of the Betty crew, Ripley is struck in the nose, and blood drips onto the floor. To depict the effect of her acid blood here and elsewhere in the film three different techniques were employed. In a few instances, acetone was dripped onto deck pieces fashioned from styrofoam, which were quickly eroded by the caustic fluid an approach used in previous *Alien* movies. However, since the gag released toxic fumes, it could only be done under very controlled conditions in second unit. A safer method, introduced by Eric Allard, entailed the use of a foaming agent dropped onto metal sections that had been previously cut away, then hot-glued back into place. As the foam reaction occurred, enhanced with smoke, the section was pulled away from behind. A shot of Ripley's blood melting through wires, sparking and short-circuiting a door mechanism, was created digitally by Duboi.



While scenes inside the Auriga were generally filmed on full-scale sets or, in some instances, miniatures a shot of Call crossing a ramp over a shipboard chasm combined a greenscreen element of actress Winona Ryder on a full-size walkway with a Jean-Marie Vives digital matte painting of the ship's vast interior.

The special effects team also provided on-set atmospheric effects, such as CO₂ and liquid nitrogen, plus smoke, sparks, bullet hits, exploding wax alien heads and an assortment of elaborate props. The practical assignment was so vast that at the peak of shooting, Allard had more than a hundred people on his crew. Among the complex props designed and built were firearms equipped to fire pyrotechnic squibs instead of blanks and a flamethrower that shot real flame. "For the flamethrower, we filled a pressure pot with gas and pressurized it with argon so there would be no oxygen in it," stated Allard. "Then we ran a high-pressure hose to a solenoid inside the gun, and ignited the gas with a pilot light system." Another prop was a wheelchair for Vriess (Dominique Pinon), the paraplegic chief mechanic of the Betty. Among the six-wheeled creation's unique features were small transverse casters on its outside wheels, front and back, that allowed the chair to turn in place without its wheels dragging a design so novel that Allard patented it. Additional props included cloning tubes, cryochambers and mechanical mules for transporting them. All Effects also provided technical set dressing for the Auriga's medlab and gun turret interior.

At the heart of the Auriga's clandestine activities are the aliens themselves, bred in captivity and confined for study in a sophisticated laboratory, called the observation room. When revealed in wide shots, the torus-shaped lab was a sixth-scale miniature set, built by Hunter/Gratzner, with a science station at its center that could rotate via motion control to line up with specific alien containment cells in the circular outer wall. The selected cell would then extend to mate up with the station window. The miniature measured thirty feet in diameter and was approximately seven feet tall, with fourteen cells filling out about 270 degrees of the torus. For most scenes, passes were made with orange cards placed in the cell windows, allowing images of alien warriors to be composited in later.

Escaping from the laboratory, the aliens soon infiltrate the ship and begin wreaking havoc. As with previous *Alien* films, visual effects would play a role in depicting the creatures, but on-set use of a suited performer was deemed essential. Gillis and Woodruff, charged with designing the alien warrior suit, drew upon their familiarity with the character and the inspiration of its original

designer, H.R. Giger who, months later, expressed outrage when Fox released the film without crediting his seminal contribution to the series. In a departure from previous incarnations, the creature's biomechanical aspects were toned down to make it look more like a true living animal. The translucent head dome, deleted in *Aliens*, was reinstated, as were the four tubular appendages on its back. Those had been eliminated in *Alien3* because the warrior, then emerging from a dog, had to move on all fours; and with the spines in place, the head could not be rotated back far enough to allow such movement. For *Alien Resurrection*, the A.I crew proposed that the function of these appendages was to secrete the resinous material the creatures used to construct their nests. "In general, there's only so much you can do within the general context of the alien creature," Woodruff remarked. "There's a lot that audiences expect of the alien, and you want to deliver that; but you also want to give them something new. For example, we made the head about eight to ten inches longer. We changed a lot of sculptural features, too, differences that we felt were improvements. But it's all based on Giger's work."

In constructing the creatures, A.I revived techniques developed on the previous films, as well as benefiting from advances in silicone materials, molding methods and the company's recent animatronics experience on the just-completed *Starship Troopers*. Improvements in the suit included a lighter head, with the weight more evenly distributed to reduce performer fatigue. As before, the head was built onto a form-fitted helmet. Sculptural detail in the neck hid two tiny eye holes covered with black screen material that afforded the wearer some modicum of vision. While simple nonarticulated heads sufficed for some shots, hero heads were either cable-operated or radio controlled, the latter featuring a pneumatically-fired striking tongue, built by John Lundberg. The tongue was so powerful, it could hit fake skulls with enough force to punch through them. Some of the suits featured cable-operated finger extensions for grabbing objects and victims. And for a shot in which the creature rises out of water, the four back spines were mechanized by James Hirahara to undulate in a disturbing manner.

Cables and tubes ran down the back of the suit and out the tail mount. Through one tube was pumped methocel drool and through another dry ice vapor for visible breath condensation. "Rather than just putting a thin glazing coat of slime on the alien," related Gillis, "we mixed up a viscous slime that made the creature look like it was under half an inch of mucous much wetter and sleeker than in the past. The vapor breath also gave it an extra fetid quality."

A harness inside the suit had a peg to which the tail could be attached, allowing the weight of the appendage to be carried somewhat comfortably. One type of harness was designed for a tail that emerged straight out the back, used when the creature was standing erect; another was for a tail that came down and aligned with the spine, for swimming



Having escaped from the lab, alien warriors begin a methodical extermination of the Auriga's human occupants. To depict the warriors, A.I revived the man-in-a-suit approach used predominantly in previous films, adding subtle design modifications that reflected the creatures' adaptive evolution, and incorporating improvements in building techniques and materials. Although some scenes were staged with up to three creatures visible at a time, most had only one with A.I co-

scenes or when the creature was climbing. Also built was a floppy tail that could be manipulated by monofilament line, and a new, self-supporting tail that had laminated polypropylene sheets inside it

founder Tom Woodruff serving as principal alien performer. Alien headgear ranged from nonarticulated stunt heads to fully articulated hero heads either radio controlled or cable operated built onto form-fitting helmets.

and required no monofilament to keep it off the floor. Apart from its self-supporting aspects, the new tail also gave a realistic whipping action when the actor swung his hips; however, the opportunity never arose to use it as intended. Instead, the tail was manipulated off-camera, separate from the full suit, for insert shots of its whipping across frame. Separate mechanical hands, clearly thinner than a human hand, were built for insert shots.

As per custom, Tom Woodruff served as principal alien performer. All of the suits were sculpted to fit his body, although there were occasions when as many as three people donned warrior suits the most that appeared together in any scene. "To disguise the fact that it was a man in a suit," noted Pitof, "the trick was to shoot the alien just right and keep it moving. We framed the shots so that we were always cutting at about mid-torso, and we kept the alien in darkness. Because the arms looked so much like human arms with their motion determined by the actor inside the suit they were shown only in quick cuts or held back and at his side." Even though the suit was photographed only above the waist with full-body views relegated to computer animation the full suit was nonetheless worn to enhance the performance of the actor inside, as well as others in the scene interacting with the creature. Besides the full warrior suits, A.I built many other representations of the creature, including dummies of dead aliens, built out of foam, and wax versions, created for underwater scenes in collaboration with All Effects.

Aliens first escape from an observation cell by tearing one of their own brood apart and using its blood to melt a large hole in the floor. A marine who discovers the scene dies when one of the aliens triggers a blast of the cryogenic gas used by scientists to subdue the creatures. As he attempts to pull away, one of his frozen arms sticks to the wall and shatters like glass. Sculpted at A.I by Mike Smithson with lab work by Steve Kuzela and Garth Winkless, and mechanics by Anton Rupprecht the arm was cable-controlled and had a squib that shattered an outer brittle resin casting. Inside the resin shell were colored powders and chunks of pink silicone simulating crystallized blood and tissue. An ear, also made of resin, was shattered by contracting a wire loop that fit inside it, while the marine's frozen face was a standard appliance, applied in a three-hour session by Smithson and Barry Koper. As a final touch, the appliance makeup was sprayed with a low-temperature melted paraffin to give it a frosted chalky-white appearance, then covered in a fine crystalline-like glitter.

With the aliens now loose and preying upon the crew, panic spreads aboard the Auriga. The vessel's commander, General Perez (Dan Hedaya), orders an evacuation into lifeboats, one of which is boarded by an alien. Perez throws a grenade into the infiltrated craft a shot that required photorealistic CG rendering, by VIFX, of the grenade hitting specific marks and rolling around the edge of the hatch before dropping inside. Scenes within the lifeboat were filmed on a partial set representing a portion of the wall and upper half of the craft, while an exterior view of the gigantic launch area was achieved as a Jean-Marie Vives matte painting. A shot of the ejected lifeboat receding down the launch tube and moving away from the ship before detonating was rendered as

a 3-D digital effect by Duboi and composited with a practical pyrotechnic element provided by Joseph Viskocil.

Running through the Auriga to escape the rampaging aliens, the human survivors stumble across the ship's medlab, where the cloning experiments were performed. There, they discover, preserved in glass specimen containers, six aborted fetuses grotesque and botched abominations the result of earlier failed attempts to produce a Ripley clone from which an alien infant could be extracted. The fetus clones, combining human and alien features, were fabricated by A.I as full-size nonarticulated dummies cast out of translucent silicone. Various artists at the studio including Jeff Buccacio, Andy Schoneberg, Yuri Everson, Steve Koch and Mike Smithson were given free reign to transform concept sketches into three-dimensional sculptures, each in his own way.

Also in the medlab, Ripley finds the still-living Clone 7 which had failed to yield a viable alien embryo. Though its facial features resemble her own, the clone is deformed and diseased, its flesh discolored. When it begs to be put out of its misery, Ripley complies, using a flamethrower to destroy both the clone and the lab. Sketches and color renderings of Clone 7 were contributed by Chris Halls. Jordy Schell then produced maquette interpretations, from which Steve Koch and Jeff Buccacio derived the full-size body. The puppet's silicone skin was heavily plasticized to make it hang or lay in folds of flesh and atrophying muscles. Mechanics, by Anton Rupprecht, included rods and cables to articulate the limbs and a bladder that pushed up two vacuformed rib shells to simulate breathing.

During filming of the sequence, the puppet was situated on a table through which Sigourney Weaver's head and neck protruded. A gelatin neck appliance blended the prosthetic body to Weaver who, along with several puppeteers, lay on a slant-board under the table. "Sigourney was extremely patient with all the crap she had to endure to make this stuff effective," recalled Gillis. "She's a very daring actor who will do whatever takes it to the next level of performance. Linda DeVetta made her look awful, with rings under her eyes and stained teeth; but for Sigourney, it just pushed the performance that much further." For a scene of the torched lab burning, A.I prepared a polyfoam stunt version of the clone. However, once on set, the stunt version proved unsatisfactory, and the hero puppet was burned instead.

Pursued by the warriors, the dwindling survivors are forced to swim through a flooded industrial kitchen. When a survey of leasable off-site tank facilities revealed that it would be more cost-effective for Fox to build one of its own, a thirteen-foot-deep tank the second largest in Hollywood was constructed on Stage 16 at the studio. Many of the water scenes, shot in the tank over a twenty-three-day period, required Woodruff to maneuver underwater in the alien suit. The only modification to the suit for the water work was a new housing for the radio control mechanism in the hero head, designed by Luke Khanlian. The range of the RC signal was dramatically diminished in the underwater environment, however; and when its effective range of just four feet was deemed unworkable, the cable-controlled head was brought in.

A major challenge in filming the underwater creature shots was providing air and direction to the essentially blind suit performer. "My face was inside the neck of the alien," commented Woodruff, "so there was no place to put any kind of eye wear that would allow me to see underwater. And there was no room for any kind of breathing apparatus because the neck was just an eighth of an

inch thick across my face. All I had was a slit in the throat where I could put an external regulator in my mouth. I would go underwater and be led into place. There was an underwater speaker to direct me. Then, as the cameras rolled, I would take the regulator out of my mouth and hand it to Rod Francis, the divemaster, who was positioned just out of frame. The moment they yelled 'Cut!', I would put out my hand, Rod would place the regulator in it, and I would put it back into my mouth. We just got into a rhythm. I had to get to a point where I trusted the people who were there to support me. If I'd thought about it more, my concern could have gotten in the way of my job. It was difficult enough for me just to perform underwater to move that big head or hold it steady without also worrying about safety issues."

In one underwater scene, an alien grabs Betty crew member Hillard (Kim Flowers) by the ankle and hauls her backward into darkness. To execute the scene, Woodruff was secured via cable to a ratchet mechanism contributed by All Effects and then to Flowers' ankle, allowing the two to be dragged backwards through about thirty feet of water. "I was locked off in the cable rig and I couldn't get out of it quickly," recalled Woodruff, "so we put a small bottle of air inside the suit, which would have given me about five minutes, if I needed it but I never felt in danger. Had things gotten bad, there were enough divers that somebody would have been there to help."

To emphasize her character's hybrid nature, Sigourney Weaver suggested that Ripley swim differently than the others in the underwater scenes. She chose a dolphin-like, up-and-down motion, achievable by being fitted with a harness and towed through the water on a monofilament line. During the underwater sequence, Johner (Ron Perlman) fires a grenade at a pursuing alien. The All Effects crew staged the effect using model rocket engines encased in underwater housings and guided on piano wire anchored inside the gun. "We would load the projectile in the gun," explained Allard, "and set off the rocket motor. The rocket would propel the grenade prop down the wire to a wax alien dummy that was rigged with explosives and fake viscera and blown up at the moment of impact."

For scenes in which the man-in-a-suit approach was unfeasible, computer generated aliens were employed. These CG images which had to intercut perfectly with footage of the A.I suit would reveal the aliens in full view, running or swimming with inhuman speed. Blue Sky Studios the New York digital house responsible for the dancing cockroaches in Joe's Apartment was assigned the slate of twenty shots. The company began work on the project in October 1996, conceptualizing shots and determining how best to accomplish them. Traveling to the West Coast whenever plate photography involving their aliens was scheduled, members of the *Blue Sky* team observed the choreography of the shots, collected camera data, took reference photographs and discussed lighting considerations.

By February, all sixteen plates for the digital alien shots had been filmed, and a May delivery date was established for *Blue Sky*. Generous by the standards of television commercial production in which the studio had considerable experience the schedule gave digital artists time to both experiment and finesse the animation. Video teleconferencing facilitated face-to-face meetings between *Blue Sky* principals in New York and the Los Angeles production staff, with materials exchanged via fax, the Internet or FedEx. In addition, a high-speed data line into the Churchill Studios facility permitted animation to be sent and viewed quickly on an Indigo workstation. If needed, *Blue Sky* personnel, led by digital effects producer Christopher Scollard, could be on set the morning following a call.

To build a digital model of the alien in its computers, *Blue Sky* obtained reference material from A.I., including full-size castings of the head and tail. These were then cyberscanned to provide a data array for the model. The process produced an extremely fine polygonal mesh that, while far too dense for the CG model, was useful as a 3-D template for fashioning a customized version of the virtual alien by hand. For the rest of the creature, A.I provided a half-scale casting of its left side that featured minimal detail on the head and tail, but a complete paint job. This casting was not scanned, but rather used as a reference for modelers Mike DeFeo, Shaun Cusick and Alexander Levenson to build the complex shape in digital form. Painters then texture-mapped the colors in the A.I reference onto the model, degrading them somewhat to match the worn appearance of the suit in the live-action.

Blue Sky animation director Jan Carlée worked closely with the production to determine how the CG alien's movements might suggest that of a real animal. "I put together a reference tape of different animals walking or swimming," stated Carlée, "and presented that to Jean-Pierre, Pitof and Erik, and we discussed the pros and cons of each. For example, in underwater scenes, the aliens' movements are kind of a composite between a sea iguana and a shark, with the shark element adding menace and a predator-like behavior. In addition, Pitof put together an animatic that combined the storyboards and the live-action plates so that everyone knew how large the creature should be in the scenes." To facilitate the animation process, and create more natural-looking movement for the warriors, the *Blue Sky* team made one modification to A.I's creature designs, slightly restructuring the legs to make them appear more animalistic and less human. With that refinement completed, animators Steve Talkowski, James Bresnahan, Doug Dooley, Nina Bafaro and Jesse Sugarman developed walk and swim cycles, also determining how the skeleton should move and the flesh deform under different conditions.

Rendering of the CG alien, with proper lighting to place the character securely and believably into live-action scenes, was achieved at a resolution suitable for each shot, but with an eye toward economy and efficiency. The most data-intensive were underwater shots of the alien swimming close to camera that necessitated quite lengthy closeups of the computer generated head. "The high-rez model that we had was about 85 megabytes of data," commented *Blue Sky* visual effects supervisor Mitch Kopelman, "which was the most complex and detailed model that we've ever made. On top of that, the closeup model required something on the order of 300 megabytes of texture maps. Fortunately, the majority of the shots were a little more reasonable, so we could do them fairly economically, without sacrificing image quality." Technical directors responsible for lighting and compositing the scenes included Rhett Bennett, David Esneault and Thane Hawkins.

Computer generated aliens were also employed in some dry settings, including shots of the creatures running down corridors and one in which an alien clambers across a launch tube and into a lifeboat. But the majority of *Blue Sky*'s work would be featured in the flooded kitchen sequence. "The underwater stuff presented a unique challenge for us," Kopelman related. "There were a lot of issues we had to deal with, such as the interaction of the alien with various set pieces. We used volumetric lighting techniques for shadow effects. There was also the effect of caustic reflections from the rippling water surface creating little strands of light cascading across objects below." Technically, the most difficult aspect of the underwater scenes was the air bubbles that had to interact realistically with the swimming aliens. "We created different layers of CG bubbles, because

the warriors would typically come from deep in the background, swimming up towards camera. We had to do a lot of interesting compositing tricks to keep that depth relation correct. Our hope was that the combination of the caustic reflections, the volumetric shadows, the interaction with the bubbles and the environment, along with the beautiful lighting that Darius Khondji had set up, would render the alien completely imperceptible as a CG effect.”

Complicating matters for the *Blue Sky* team were the disappointing results of underwater photography involving the A.I alien suit and dummies. Neither Tom Woodruff, hampered by the restrictive suit, nor the dummy appeared to swim convincingly. In addition, the foam latex creature, so vibrant on stage, simply did not look pleasing in the watery environment. “The alien had many specular highlights when shot on stage, and those lent to its eerie and beautiful look,” Erik Henry observed. “But when we got it underwater, all of those highlights disappeared, and it tended to look dull. The details suddenly seemed very sculptural and the colors washed out. Water just wasn’t very flattering to the character.” The unsatisfactory appearance of the alien underwater presented the CG team with a dilemma in that their creature had to look better than the live-action figure, but not so much better that it would fail to match. In the end, live-action footage for the sequence served principally as reference for *Blue Sky*, with only a few underwater closeups of Woodruff remaining in the final cut.

“Another big surprise,” commented Henry, “was discovering that to make the CG creature look like it was really in the water, we had to put more and more atmosphere between camera and the creature, even though *Blue Sky* had matched the reference footage of the dummy or Tom. The added atmosphere helped eliminate some of the qualities that made it look like a CG character. We tried to keep it in darkness for the most part. We also added more bubbles to some shots to help us out.”

When the fleeing humans emerge from the water, they discover that the bottom of the elevator shaft in which they find themselves is now a birthing chamber filled with alien eggs from which face-huggers a staple of the *Alien* franchise are about to emerge. Like the alien warriors, the eggs underwent some design modifications from previous incarnations. Mechanized petals enabled the eggs to open and peel back more smoothly than



Intercut with footage of the A.I aliens were computer generated counterparts, created by Blue Sky Studios for scenes requiring full-body views of the fearsome creatures running, jumping or swimming. Blue Sky animator James Bresnahan examines an underwater shot, one of several in a sequence where aliens ambush surviving crew members as they attempt to navigate a flooded industrial kitchen.



While underwater scenes constituted the bulk of the computer animation work, one notable exception was a shot in which a warrior, in hot pursuit of human prey, launches itself out of the water and onto a maintenance ladder.

before. A hero egg also featured cables allowing the lips of the petals to undulate and flex, and the entire egg could make small organic movements. Inside the egg was a silicone membrane through which the face-hugger could be glimpsed. As the face-hugger emerged, that membrane would split and peel away.

Several versions of the face-huggers were fashioned. Cable-operated puppets were employed when very fine finger articulation was required. For greater movement of the body and at the knuckles, a hand puppet was built that featured mechanical finger extensions for manipulation of the spindly digits. Finally, there were stunt versions. For a scene in which a face-hugger springs from an egg onto Ripley's face, the hand puppet was utilized first to depict the beast crawling out of the egg, then replaced with a stunt version, pulled along with monofilament line. For the actual strike, a third puppet was attached to Weaver's face and yanked off. The resulting footage printed backwards was later digitally enhanced to make the tail appear to wrap around Ripley's neck in a realistic fashion.



Making their way to the Betty in a last-ditch effort to escape the marauding aliens, survivors stumble across the Auriga medlab, where six aborted fetuses in specimen jars attest to earlier botched attempts to produce a Ripley clone. Artists at A.I were given wide creative latitude in fabricating the figures displayed in the lab.

The desperate humans retaliate by firing grenades into the egg chamber. Photorealistic computer animation was required for the grenades, which had to follow precise paths in extreme slow-motion, sometimes appearing very large in frame, while staying in focus the entire time. The CG grenades bounce off of the reflective glass bottom of the elevator and ricochet to connect with practical explosions.

As the survivors climb a maintenance ladder toward safety, an alien launches itself out of the water with a powerful thrust, landing on the ladder just below the fleeing humans. The live-action plate for the CG alien utilized an interactive gag created by All Effects, which entailed rigging a black life-size dummy alien with cables and using a pneumatic ratchet and pulleys to yank it rapidly out of the water. The dummy was then replaced with its digital counterpart, created by John Siczewicz at *Blue Sky*. Before the humans can reach safety, Christie (Gary Dourdan) falls to his death from the ladder, blinded when the alien spits acid into one of his eyes. Dubois inserted the phlegm wad into the scene as a CG element after a practical effect proved unsatisfactory. A.I. produced a makeup for the stricken victim, consisting of a contact lens and prosthetic appliance. Dry ice smoke was pumped through tiny tubes running from the appliance to behind the actor's head. Those practical fumes were subsequently augmented by Dubois from a library of smoke elements filmed against a black background. The sequence also required extensive wire removal, since the actors had been fitted with flying rigs as a safety precaution. These wire removals plus diver removals in some of the underwater footage were accomplished by Vertex International, a Taiwanese company that worked on approximately forty shots in the film. With some of the shots featuring a moving camera and rather large-diameter cables vibrating in front of actors' faces, such extractions were particularly taxing.



Mike Smithson adds finishing touches to one of the fetus sculptures.



Steve Koch and Jeffrey Buccacio sculpt the body of Clone 7, a still-living, but grotesquely malformed Ripley look-alike discovered in the medlab. Filming of the scene was accomplished with the articulated puppet positioned on a specially built laboratory table, through which Sigourney Weaver's real head and neck protruded.

During the struggle in the elevator shaft, Dr. Wren (J.E. Freeman) one of the Auriga scientists responsible for cloning the aliens shoots Call in the abdomen. The wound devised by A.I as a false torso shell attached to Winona Ryder and filmed from the front only reveals that Call is an android. For a later scene in which she must insert a data probe into her forearm to access plans from the Auriga's main computer for an escape route to the Betty, a silicone replica of Ryder's arm and hand, equipped with mechanisms to articulate the fingers, was built by A.I and strapped to the actress.

As the group pushes on, Ripley becomes separated, falling into a pit filled with aliens, all intertwined in a slimy mass. The disturbing image of the 'viper pit' was concocted using four soft polyfoam mats covered with sculpted alien shapes. Butted together on an elevated platform, the mats created a twenty-by-twenty-foot surface. A hole in the center, where one corner of each mat joined, allowed Weaver to slip through, as if disappearing into the writhing horde. As many as thirty puppeteers manipulated the mats from beneath, creating an overall undulating movement, while two suited aliens, along with miscellaneous limbs and tails, moved about on top of the mass.

Ripley awakens to find herself in a large chamber where the alien warriors have sequestered their pregnant queen. Rather than fashion the queen from scratch, A.I borrowed the queen hero head built for *Aliens* from Bob Burns a Los Angeles collector of science fiction cinema memorabilia and thoroughly refurbished it, adding a bit more detail and repainting it for an early closeup shot. Seeking other shortcuts to accommodate scheduling and budgetary constraints. Woodruff and Gillis also acquired the original molds for the body of the queen, which had been loaned to a firm in Colorado that was running polyfoam replicas of the character for commercial purposes. The molds were in such poor shape, however, that they required considerable reworking.

To eliminate the need for human performers inside the giant queen the approach taken in *Aliens* the new version, mechanized by Luke Khanlian, was equipped with extensive hydraulics. Aquadraulics which utilize water rather than hydraulic oil to move large rams were also employed, allowing for more kinetic movements, particularly of the large and heavy head. Limbs and other features were manipulated via cables, while tubes running to the head were utilized for pumping simulated saliva and condensed breath. Dan Brodzik and Mike Larrabee applied a new color scheme to the queen, using sepias and a light fogging of pearlescent blue on the edges.

The genetic crossing of Ripley and the alien strain has produced a more mammalian queen, resulting in a creature capable of propagating via gestation. It was therefore determined that her progeny, dubbed the Newborn, would also have both alien and human characteristics. "With the Newborn," enthused Gillis, "we got to put our stamp on the *Alien* series in a very decisive way, taking the alien concept into a totally new direction. Chris Halls worked on the initial design, and Jordu Schell sculpted maquettes, carrying the design another step further. We could have gone in a million different directions, but Jean-Pierre had a lot of ideas about what he wanted to see, and responded specifically to several of the sketches we showed him. He chose to go with an almost human skeleton, with alien features in the head and face." Although the script had described the Newborn's face as bearing a similarity to Ripley's, the idea was easy to imagine but difficult to execute. "This was one of those concepts that people talk about a lot, but is impractical in reality. The problem is that you have a beautiful woman, and what you're hoping to create is a very scary

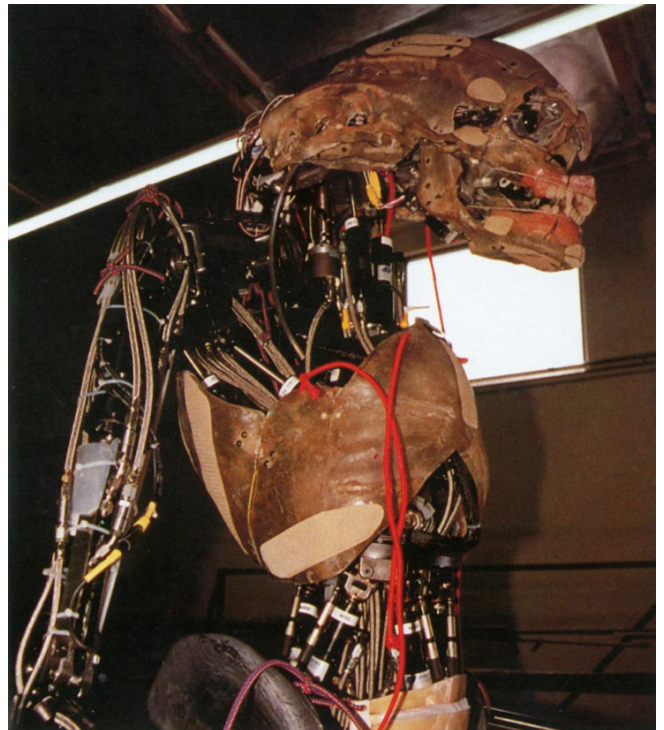
monster. It doesn't work. So we just tried to get a certain amount of humanity into the face, which we felt would be startling enough."

Having finally nailed down the design, A.I tackled its most challenging assignment to date (matchcase) the fashioning of a full-size Newborn puppet. "The Newborn was a state-of-the-art, incredibly complicated animatronic character," Gillis remarked, "and it had to be constructed within a very short time frame. Luckily, we were able to build on our animatronic experience from *Starship Troopers*, taking the same crew and moving them right into *Alien Resurrection*."

The puppet, standing more than eight feet tall and supported by a boom, had a spindly frame that allowed very little room for mechanisms inside. Operated by hydraulics, it was capable of a full range of motion above the waist, with legs actuated via rods. The supporting boom was attached to a Chapman camera dolly base, which allowed for fluid motion. While nearly all of the servo valves and electronics were mounted externally, inside the puppet was a mechanism that enabled the creature to stretch out or compress down as required. The head contained servo controls for facial articulation and featured a double-jointed jaw that could open wide for scenes requiring the creature to perform such actions as biting into the head of a victim. The skin was made of silicone, with gel-filled pouches fitted beneath specific fleshy areas to hang and jiggle realistically. To make the extremely thin arms stronger and more durable and allow them to support the weight of the hydraulic rams foam latex skin was used rather than silicone. Methocel slime and an effective paint job by Brodzik and Larrabee disguised the difference in translucency between the two materials. Normal operation of the hero puppet required five body puppeteers, five facial puppeteers, technicians to operate the computer, and a host of other support personnel. Duboi subsequently removed the boom and rods, and enhanced the Newborn footage by adding several morphs.



In a secure chamber, where she has been sequestered by her warriors, the gestating alien queen gives birth. A.I recycled and refurbished an existing alien queen head and the original body molds created for Aliens to produce the animatronic creature. Wholly original in design was the Newborn, conceived and fashioned by A.I with features that reflected its dual human-alien origins.



Because its mechanism would not fit within the hero head, a separate insert head was fashioned for shots featuring the Newborn's two-foot-long, snaking tongue. Designed by David Penikas and built by Steve Stewart, the tongue was mounted on a cable-operated track that extended out the back of the head, and was hidden by careful framing of each shot. A.I also built a quarter-scale rod puppet of the Newborn intended for full-body shots of its walking. However, all of the envisioned shots were achieved with the full-size animatronic, so the rod puppet never went before the cameras.

Scenes of the queen and Newborn later restaged digitally at height-four-fifths scale, with the queen puppet operated by handpuppets and external rod puppeteers. The queen was capable of refined head and body movement.

Secured to the floor of the chamber by the resinous secretions of her warriors, the queen, in a supine position, prepares to give birth. To stage the graphic sequence, thirty puppeteers were positioned below set level, operating both the queen and the Newborn emerging from the birth sac a foam latex bag manually undulated from within, then split and pulled back as the baby is born. "It was quite dramatic," commented Gillis. "It occurred to me as I watched it on the monitor that this is what really takes the Alien series into its next phase. Here you have the old alien, the queen still beautiful, still a great design but now there's a totally new being born out of it. It's a nice moment when the queen greets her child, who then turns on her and rips her face off."

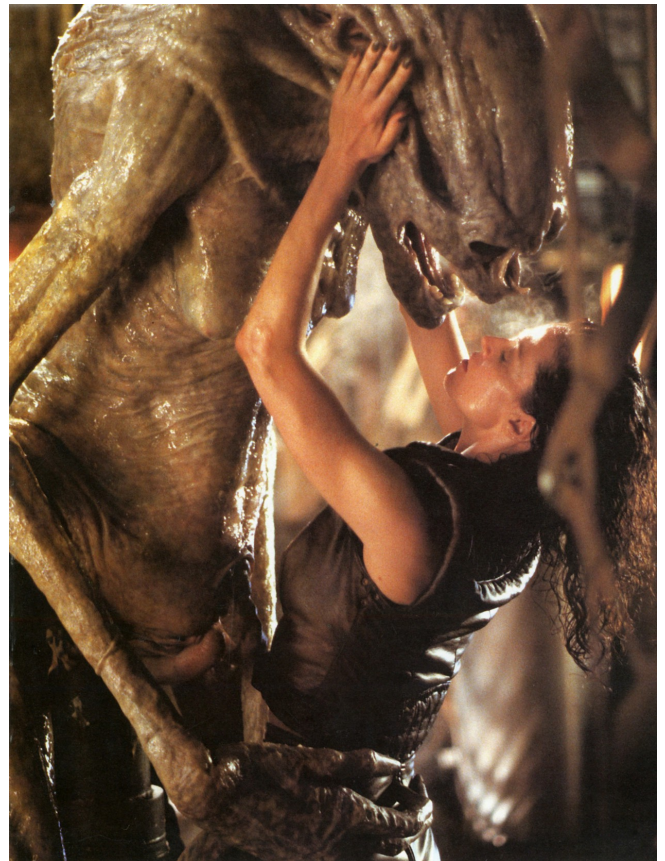
Ripley attempts to calm the raging beast, revealing an empathic bond with the Newborn. In a last-ditch effort to escape, however, she makes a final dash for the Betty being readied for departure by the remaining survivors jumping the chasm between the ship and the docking pier in a leap made possible by her alien-enhanced strength. A stunt double, wearing a wire rig, was filmed mimicking the jump while being flown across a similar distance via an All Effects overhead track system. Duboi later manipulated the footage to connect the leap with the airlocks. Since it was impractical to use a bluescreen background for the jump, Duboi performed a meticulous digital rotoscope removal of the stuntwoman from the concrete stage floor visible behind her.

Shots of the Betty docking and later breaking free from the doomed Auriga were accomplished with an enlarged sixteenth-scale miniature of the magnetic coupling arms and a segment of the Betty's hull. An electromagnet was concealed in the hull opposite a steel plate in the end of the arm to effect an abrupt contact and release of the arm from the hull. The action was filmed high-speed to impart a feeling of mass, with the mechanization puppeteered, instead of motor-driven, to provide more fluid motion. For the departure shot, the Betty hull piece was on a spring to allow it to sway a bit as it broke free of the arm. Hunter/Gratzner also installed lines for ejecting CO2 gas to create puffs of vapor during the breakaway.

On board the Betty, Purvis (Leland Orser), one of the implant subjects impregnated with an alien spore, becomes the final host to fall victim to the chest-burster growing within him. Determined to take one of his killers with him, Purvis pulls Wren's head against his chest just as the creature emerges, bursting through so forcefully that it erupts right through the scientist's face. The cable-operated chest-burster used earlier in the Ripley surgery scene provided the required action of the birth, as well as subsequent shots in which the beast struggles and dies in a hail of bullets from the surviving humans.

Also featured in the scene was a view of the chest-burster moving up Purvis' esophagus moments before its emergence. A.I created a delicate and slightly oversized silicone esophagus held in place with plexiglass rings and lit from the outside into which the chest-burster puppet was placed and slid up towards the camera. An endoscopic lens, with an attached ring of fiber optics supplying internal illumination, recorded the action. Duboi then provided some morphing to link the A.I work with the camera going into the victim's mouth and down his throat.

Throughout the main unit shoot, Jeunet had not felt comfortable with the scripted ending of the movie, which had an unarmed Ripley fighting the Newborn, after it follows her into the cargo hold of the Betty. To Jeunet, the combat seemed unbelievable and the Newborn's demise insufficiently compelling. Several alternate endings were contemplated before a solution was found in the resolution of another troublesome scene. As originally scripted, General Perez was to have been dispatched earlier in the movie, slowly sucked into space through a small hole in an Auriga window made by a splash of alien blood. Although there was concern that the scene would be perversely funny, the greater fear was that its graphic nature would prevent the film from receiving its desired rating. When video tests of A.I's work on the sequence were shown to Jeunet, however, the director became very excited. The results held such promise that he decided to use the idea for the ending instead and have the Newborn sucked out the spaceship window. Because it was a monster rather than a man being killed in this horrific manner, the scene could be made even more grisly without fear of a ratings problem.



Having established an empathetic bond, Ripley soothes the traumatized infant moments after its birth.

Significantly, it is Ripley who initiates the action, intentionally cutting her hand on the Newborn's teeth and flicking her blood onto the window. The acid effect on the glass was accomplished by All Effects. "To produce the hole forming from the blood splatter," explained Allard, "we used a CO2 laser to burn a thin piece of clear acetate, matching an insert shot, provided by the production, of blood hitting the window." On set, Allard placed air movers behind the real window, with the glass removed, and shot elements of sparks, liquid nitrogen and steam being sucked into it. Other elements, such as CO2, fog, smoke and steam, were photographed separately in larger scale for later compositing into the scene.

Several stages of puppets were employed for the gradual expulsion of the creature through the window, each stage aligned using a video switcher to compare present setups with previous takes. The hero puppet was utilized for an initial shot of the Newborn slamming against the window, which was backed by a process screen. In subsequent shots, that puppet was replaced with a cable-operated 'death' puppet, which utilized the hero head. Articulation included overall writhing, limbs dislocating and collapsing backwards, and skin that could be pulled from behind with cables. The next stage featured a 'stomach split' puppet. As skin pulled tight across its prescored abdomen, silicone intestines and other organs were pushed through, before being yanked back with a cable. The 'flesh donut' puppet came next a head encircled with bunched-up skin, mechanized to allow the flesh to disappear out one of the eye sockets. A separate breakaway skull was used for the final stage as the creature collapses and exits the hole. Shots of viscera spewing into space were achieved using elements of various lumpy fluids injected into water, with the footage subsequently manipulated digitally. Duboi smoothed out the blends from stage to stage, adding morphs, image warping and dissolves, and compositing in smoke and debris elements. Where



Later, discovering the creature in the cargo hold of the Betty, Ripley becomes the instrument of its doom flicking a drop of her own acid blood at a window to create an opening that sucks the Newborn out. Shots of its gradual expulsion through the window were filmed progressively using several stages of rod- and cable-controlled puppets, built and operated by A.I.



necessary, camera shake was added to speed up or slow the action.

The writhing Newborn is sucked into the vacuum of space. Digital sweetening of the shots, by Duboi, blended the stages of the creature's grisly demise.

Having been set for an automatic return trajectory to earth, the Auriga, now overrun with aliens, is programmed by Call to plunge directly into the atmosphere and explode upon impact. To film its destruction, Joe Viskocil rigged a series of charges which, when detonated, exploded in succession, as if consuming the long ship segmentally. Duboi composited an animated shockwave expanding from the blast.

The hasty departure from the Auriga and battle with the Newborn on the cargo deck has left the Betty in trouble, as well. During reentry, her outer hull heats up dangerously. The effect was a challenging one to produce with the miniature. "We really didn't want to burn up the model," explained Ian Hunter, "so once we were satisfied with the beauty passes, we wrapped the Betty in velvet and hooked up a manifold with a dozen lines to blow white nitrogen against the model. There were fans and air movers to whip the vapor around, and we flagged off the gas sources so that all the camera saw were streams of nitrogen hitting the Betty shape. We photographed it at about eight or twelve frames per second to ensure that the gas matched the shape and moves of the miniature. The white gas was colored orange-red in postproduction so that it looked like flames emanating from the ship's surfaces. Tom Quinn and Paul Pouter wrangled the reentry."

In an eleventh-hour decision to revamp the film's concluding sequence, Jeunet turned to Digiscope for a dramatic series of shots in which Ripley and Call view the approaching earth through the ship's window. Utilizing a combination of digital paint, animation and compositing, the shots were derived from a single NASA satellite photo and cloud stills. "To highlight the homecoming," related Inferno artist Todd Mesher, "the director wanted reflections of earth in the windows of the spaceship. This was complicated by the need for continuity of land mass, as each of the eight shots in the sequence were cut back to back." For views of the model ship emerging from cloud cover, artist Grady Cofer used 2-D tracking animation, manipulating the earth plates and adding camera float in the composites, working all eight shots together as one for continuity.

Despite language barriers, challenges encountered in shooting the miniatures, and an unforgiving schedule, the effects team for Alien Resurrection completed its assignment on time, and without compromise. "Our foresight in starting the work early certainly helped us succeed," Erik Henry observed. "There was a desire on the part of Jean-Pierre, Pitof and myself to lay money issues aside and just make the shots look as real as possible. And we definitely made the right decision on who to go to for these effects. Their hearts were in the right place and, fortunately, so were their talents."

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ALIEN RESURRECTION

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